C. Sloan

Ballistic Missile Defense Final Programmatic Environmental Impact Statement

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Organization

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BALLISTIC MISSILE DEFENSE

FINAL PROGRAMMATIC

ENVIRONMENTAL IMPACT STATEMENT

OCTOBER 1994

PREPARED FOR THE

Ballistic
Missile
Defense
Organization

BY THE

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

COVER SHEET

BALLISTIC MISSILE DEFENSE
FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

a. Lead Agency: Ballistic Missile Defense Organization (BMDO)

b. Cooperating Agencies: U.S. Air Force, U.S. Army, U.S. Navy, U.S. Department of Energy, National Aeronautics and Space Administration

c. Proposed Action: The Preferred Action is to continue a National Missile Defense (NMD) Technology Readiness Program. Although only analyzed from a cumulative perspective, the Preferred Action also assumes continuation of the Theater Missile Defense (TMD) Program. Both programs were initiated under existing Congressional and legislative direction. The Preferred Action contains no changes from current management direction or level of management intensity; therefore, this action is considered to be the equivalent of the traditional No Action Alternative.

d. Inquiries on this document should be directed to: Major Thomas LaRock, OATSD-PA, The Pentagon, Washington, DC, (703) 697-5131

e. Designation: Final Programmatic Environmental Impact Statement (FEIS)

f. Abstract: Pursuant to the National Environmental Policy Act of 1969 (42 USC 4321 et seq.) and Department of Defense Directive 6050.1, this Programmatic Environmental Impact Statement (PEIS) analyzes the potential environmental effects associated with research and development of a Ballistic Missile Defense (BMD) system capability by the Department of Defense (DoD). The BMD Program seeks to develop systems and capabilities to protect the United States and areas of vital interest to the United States against the accidental or unauthorized launch of ballistic missiles. The BMD Program includes TMD and NMD initiatives under the direction of the BMDO. The TMD segment includes transportable systems to defend expeditionary elements of the Armed Forces of the United States deployed abroad, and to defend its friends and allies against short- and medium-range missiles. The BMD PEIS focuses on the research, development, and testing of NMD elements. It covers the potential cumulative impacts from the entire BMD Program, including TMD, because the technologies, testing, and development have potentially similar environmental effects. Ongoing NMD activities are currently part of a Technology Readiness Program to facilitate development of an effective NMD system on short notice. These activities are described as the Preferred Action. Several other alternatives are proposed for carrying the NMD system into the engineering and manufacturing development (EMD) phase of the DoD system acquisition process. They are described as the System Acquisition Alternatives in this PEIS. TMD research, development, and testing activities would continue independent of the decision reached upon review of this PEIS. Potential environmental impacts beyond development and testing activities for the Alternatives to the Preferred Action are discussed to provide DoD decision makers with information on potential environmental impacts related to the life-cycle of full-system acquisition. This PEIS serves as the foundation from which future, more detailed, site-specific environmental documentation could be prepared.

Summary

EXECUTIVE SUMMARY

This Programmatic Environmental Impact Statement (PEIS) analyzes the potential environmental effects associated with research and development of Ballistic Missile Defense (BMD) system capability by the Department of Defense (DoD). The BMD Program seeks to develop systems and capabilities to protect the United States against accidental, unauthorized, and limited ballistic missile strikes and to defend U.S. troops, allies, friends, and areas of vital interest to the United States against ballistic missiles launched against them.

This EIS is considered "programmatic" because it examines environmental issues associated with the broad research, development, and testing activities of the BMD Program, discusses the major highlights, and considers general classes of alternatives of the program. The BMD Program includes Theater Missile Defense (TMD) and National Missile Defense (NMD) initiatives under the direction of the Ballistic Missile Defense Organization (BMDO). The TMD segment includes transportable systems to defend expeditionary elements of the Armed Forces of the United States deployed abroad and its friends and allies against short- and medium-range missiles. The NMD segment consists of ground- and space-based elements to defend against long-range ballistic missiles aimed at the United States. The programmatic nature of this document allows for consideration of environmental issues associated with the program elements while various technologies are under development. This PEIS does not focus on project or site-specific environmental concerns. Subsequent National Environmental Policy Act (NEPA) documentation could tier from this PEIS, and concentrate on the site and project specific actions under consideration.

The Council on Environmental Quality regulations implementing NEPA (40 CFR 1500-1508); DoD Directive 6050.1, *Environmental Effects in the United States of Department of Defense Actions*; and the applicable service environmental regulations direct DoD officials to consider environmental consequences when authorizing or approving federal actions. Environmental impacts of specific individual BMD activities and technologies are evaluated in existing NEPA documents. This PEIS evaluates the programmatic and cumulative impacts of the BMD Program as a whole (encompassing both TMD and NMD). The BMDO prepared a separate PEIS for the TMD Program, because TMD has an independent utility, purpose, and need from NMD. This PEIS incorporates the September 1993 TMD PEIS by reference. The TMD PEIS reviews life-cycle environmental effects of research, development, and testing; production; basing; and decommissioning of system alternatives for the TMD Program.

This BMD PEIS focuses on the research, development, and testing of NMD elements. It covers the potential cumulative environmental impacts from the entire BMD Program, including TMD, because the technologies, testing, and development have potentially similar environmental effects. Ongoing NMD activities are currently part of a Technology Readiness Program to facilitate development of an effective NMD system on short notice. These Preferred Action activities are described in this PEIS. They are ongoing programs initiated under existing Congressional direction and include research, development, and testing of NMD elements under the Technology Readiness Program. Since the Preferred Action does not represent a change in the Technology Readiness Program, it is equivalent to the traditional No Action Alternative.

Several other alternatives are proposed for carrying the NMD system into the engineering and manufacturing development (EMD) phase of the DoD system acquisition process. They are described as the System Acquisition Alternatives in this PEIS. TMD research, development, and testing activities would continue independent of the decision reached upon review of this PEIS.

For the System Acquisition Alternatives to the Preferred Action, potential environmental impacts beyond development and testing activities are discussed to provide DoD decision makers with information on potential environmental impacts related to the life-cycle of full-system acquisition. This PEIS serves as the foundation from which future, more detailed, site-specific environmental documentation could be prepared.

The public was notified of the purpose and intent of this PEIS and invited to express their concerns about potential environmental issues associated with the implementation of the BMD Program. The public scoping period for the BMD PEIS began on February 14, 1992, and ended on March 6, 1992, with public hearings held in Washington, D.C. and Los Angeles, California. The most frequently raised comments concerned issues outside the scope of the environmental analyses in this PEIS. These issues included: the need for BMD; budget allocations; procedural problems related to NEPA; nuclear weapon dangers; arms reductions; and potential contravention of the Anti-Ballistic Missile Treaty. Other more pertinent comments received and addressed in this PEIS were related to program issues, hazardous and radioactive materials and wastes, natural resources, safety, non-ionizing radiation, and general cumulative impacts.

FORMAT OF THIS PROGRAMMATIC EIS

This PEIS is divided into eight chapters. Chapter 1.0 provides an introduction and discussion of the purpose and need for the BMD Program. Chapter 2.0 details the Preferred Action and System Acquisition Alternatives including descriptions of the various NMD program elements. Chapter 3.0

describes the typical ranges of the natural and human environment potentially affected by BMD actions. Chapter 4.0 evaluates the environmental impacts of the alternatives described and presents measures to mitigate substantial impacts. Chapters 5.0 and 6.0 present information on consultation and coordination and the list of preparers and contributors, while Chapter 7.0 is an index of document subjects. Chapter 8.0 presents all public comments and responses to the BMD Draft PEIS which have been incorporated in this document. Several appendices present a glossary of terms and acronyms/abbreviations, NEPA-related information (e.g., the Notice of Intent and mailing list), as well as other technical background information.

THE PREFERRED ACTION AND SYSTEM ACQUISITION ALTERNATIVES

The Preferred Action, the NMD Technology Readiness Program, and System Acquisition Alternatives infuse new technologies into the development of the NMD systems but do not procure or acquire full operational systems. The program involves development of technologies and test systems for battle management/command, control, and communications (BMC/3); ground-based sensors (GBS); ground-based interceptors (GBI); and space-based sensors (SBS).

This PEIS evaluates three NMD System Acquisition Alternatives in addition to the NMD Technology Readiness Program, the Preferred Action. TMD research, development, and testing would continue under all four of these alternatives. The three System Acquisition Alternatives would involve carrying the NMD system into the EMD phase of the system acquisition process. Additional NEPA analyses and documentation will be required to support a decision to produce or deploy an NMD system. The three System Acquisition Alternatives are:

- The Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative (Alternative A),
- The All Ground-Based System Acquisition Alternative (Alternative B), and
- The Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative (Alternative C).

Several other alternatives, including an all space-based system and a space-based sensors and interceptors and ground-based sensors system were considered but not carried forward for further analyses.

ENVIRONMENTAL SETTING

The environmental setting establishes the frame of reference for assessment of potential environmental consequences from the NMD alternatives. All NMD testing activities will be located in the region of analysis (ROA) which encompasses the continental United States, Alaska, Hawaii, and the Pacific region associated with the Kwajalein Missile Range, located in the Republic of the Marshall Islands. No specific locations have been selected within the ROA for most of the follow-on NMD activities. This PEIS analyzes a broad program, including potential future life-cycle activities, without detailed site-specific characterizations. The specific environmental setting at locations ultimately selected for NMD activities will be considered in site-specific NEPA analyses and documents tiered from this PEIS.

Topics chosen for analysis in this PEIS were based on public comments and probable consequences of the BMD Program as implemented under any of the alternatives. These topics are:

- Air quality
- Upper atmosphere
- Electromagnetic radiation
- Hazardous materials and waste management
- Noise
- Safety
- Surface water
- Groundwater
- Visual resources
- Cultural resources and native populations
- Biological resources and wetlands
- Land use
- Socioeconomics
- Geology, soils, and prime and unique farmland

ENVIRONMENTAL CONSEQUENCES

Most activities under the Preferred Action or under the development and testing life-cycle phase of the System Acquisition Alternatives would not result in significant environmental impacts. The potential environmental consequences of each alternative are summarized and compared in Table ES-1. The summary and comparisons address the Preferred Action and the development and testing phase of the System Acquisition Alternatives. TMD research, development, and testing activities would proceed under all of the alternatives considered in this PEIS, including the Preferred Action.

Because TMD impacts would not differ under any of the alternatives, they are not included in Table ES-1 or discussed in the following subsections. The Theater Missile Defense Final Environmental Impact Statement (FEIS)

Table ES-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 1 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Air Quality	Emissions from infrequent launch and test-fire exhaust clouds. Very slight emissions from handling and combustion of materials containing hazardous air pollutants.	Emissions could be slightly greater than under the PA and other alternatives since more launch vehicles would be required. Program is more extensive than under the PA or other alternatives.	Emissions could be slightly less than under the PA and other alternatives, since fewer launches would take place.	Emissions could be slightly greater than under the PA and Alternative B since there would be more launches. However, emissions could be less than under Alternative A since there would be fewer launches.
Upper Atmosphere	Limited use of Class I ozone-depleting substances with phaseout by 1996. Possible limited use of Class II ozone-depleting substances with phaseout by 2000. Very minor contribution to global warming. Very minor contribution to ozone depletion.	Emissions of ozone-depleting and global warming substances could be greater than under the PA and other alternatives since more launch vehicles would be required. Program is more extensive than under the PA.	Emissions of ozone-depleting and global warming substances could be less than under the PA and other alternatives since there would be fewer launches.	Emissions of ozone-depleting and global warming substances could be slightly greater than under the PA and Alternative B since there would be more launches. However, emissions of these substances could be less than under Alternative A since there would be fewer launches.
Electromagnetic Radiation (EMR)	Directional, high-frequency EMR from ground-based sensors (GBSs) and ground-entry points (GEPs) may affect occupational workers and wildlife.	Impacts could be equal to the PA and other System Acquisition Alternatives since GBS and GEP testing would be at similar levels.	Impacts could be equal to the PA and other System Acquisition Alternatives since GBS and GEP testing would be at similar levels.	Impacts could be equal to the PA and other System Acquisition Alternatives since GBS and GEP testing would be at similar levels.
Hazardous Materials and Waste Management	Accidental releases of hazardous materials are readily preventable for the PA and each alternative. Very limited generation of hazardous waste.	Generation of hazardous waste could be slightly greater than under the PA due to the programs being more extensive. Hazardous waste generation would be about the same as under the other System Acquisition Alternatives.	Generation of hazardous waste could be slightly greater than under the PA, but about the same as the other alternatives.	Generation of hazardous waste could be slightly greater than under the PA, but about the same as the other alternatives.

Table ES-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 2 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Noise	Infrequent, brief noise disturbances to residents close to existing Government launch and flight test installations.	Infrequent, brief noise disturbances could be slightly more numerous than under the PA and other alternatives due to an increase in launches.	Slightly fewer launches could have less impact than under the PA and other alternatives.	Infrequent, brief noise disturbances could be slightly more numerous than under the PA and Alternative B due to an increase in launches, but less than under Alternative A since fewer launches would take place.
Safety	Rigorous safety precautions necessary for occupational workers. Very little danger to public.	Somewhat more occupational workers requiring rigorous safety precautions than under the PA and other alternatives, since more extensive testing including flight test activities anticipated.	Slightly fewer occupational workers requiring rigorous safety precautions than under the PA and other alternatives.	Somewhat more occupational workers requiring rigorous safety precautions than under the PA and Alternative B, since more extensive testing activities anticipated. Fewer workers would require rigorous safety precautions than for Alternative A since less extensive testing activities anticipated.
Surface Water	Deposition from infrequent launch and test-fire exhaust clouds. Falling solid debris from infrequent launches and GBI test flights could require removal from near-shore and inland waters. Accidental contamination by spills, sedimentation, and runoff readily prevented.	Impacts to surface water could be slightly greater than under the PA and other alternatives since more extensive testing activities anticipated.	Impacts to surface water from exhaust clouds and falling debris could be slightly less than under the PA and other alternatives since less extensive testing activities anticipated.	Impacts to surface water from exhaust clouds and falling debris could be slightly greater than the PA and Alternative B since more extensive testing activities anticipated. However, impacts could be slightly less than under Alternative A since fewer launches would be required.

Table ES-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 3 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Groundwater	Water consumption too low to threaten most aquifers with overdraft, land subsidence, or saltwater intrusion . Accidental contamination readily prevented.	Slightly higher water consumption than under the PA and other alternatives since more extensive testing activities are expected.	Water consumption could be less than for the PA and other alternatives due to a lower level of testing.	Slightly higher water consumption than for the PA and Alternative B since more extensive testing activities are expected. Water consumption could be slightly less than under Alternative A since less testing is expected.
Visual Resources	Compatible with existing military, industrial, or isolated settings.	Compatible with existing military, industrial, or isolated settings.	Compatible with existing military, industrial, or isolated settings.	Compatible with existing military, industrial, or isolated settings.
Cultural Resources and Native Populations	Slight potential to disturb intact historic or surface or subsurface archaeological resources. Slight potential to interfere with Native American activities.	Slightly more potential for impacts to cultural resources than under PA and Alternative C, since this alternative has a more extensive testing program. Slightly less potential for impact to these resources than under Alternative B, since less land would likely be disturbed.	Slightly more potential for disturbing historic or archaeological resources than under the PA and other alternatives.	Slightly more potential for disturbing historic or archaeological resources than under the PA. Slightly less potential for disturbing these resources than for the other alternatives.
Biological Resources and Wetlands	Slight encroachment into undisturbed natural habitats and increase in noise impacts to wildlife. Wetland fill only under Section 404 permits (33 CFR 330).	Slightly more encroachment into undisturbed natural habitats could be possible under this alternative than under the PA and Alternative C but less encroachment than under Alternative B. Potential noise impacts could be slightly greater for this alternative than for the PA and other alternatives since there could be more launches. Wetland fill only under Section 404 permits (33 CFR 330).	Slightly more encroachment into undisturbed natural habitats and fewer noise impacts to wildlife could be possible under this alternative than under the PA and other alternatives. Wetland fill only under Section 404 permits (33 CFR 330).	Slightly more encroachment into undisturbed natural habitats could be possible under this alternative than under the PA but less than for the other alternatives. Potential noise impacts could be slightly greater than for the PA and Alternative B but less than for Alternative A. Wetland fill only under Nationwide General Section 404 permits (33 CFR 330).

Table ES-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 4 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Land Use	Would primarily utilize land already dedicated to similar activities. Would be compatible with adjacent land uses.	Slightly more land could be dedicated under this alternative than under the PA and Alternative C, since this alternative has a more extensive testing program. Slightly less land could be dedicated than under Alternative B. Would be generally compatible with adjacent land uses.	Slightly more land may need to be dedicated under this alternative than under the PA and other alternatives, since this alternative has a more extensive testing program. Would be generally compatible with adjacent land uses.	Slightly more land may need to be dedicated under this alternative than under the PA, since this alternative has a more extensive testing program. However, less land may need to be dedicated than for the other alternatives. Would be generally compatible with adjacent land uses.
Socioeconomics	Primarily use existing staff levels; some minor staff augmentation possible at some locations. Slight potential for localized economic and public service effects and short-term housing shortages.	Slightly higher level of staff augmentation could be necessary under this alternative than under the PA and other alternatives.	Slightly higher level of staff augmentation could be necessary under this alternative than under the PA. Slightly lower levels of staff augmentation could be necessary than for the other alternatives.	Slightly higher level of staff augmentation could be necessary under this alternative than under the PA and Alternative B. Slightly lower level of staff augmentation could be necessary than for Alternative A.
Geology, Soils, and Prime and Unique Farmland	Compatible with geologic setting. Limited extent of soil disturbance. Little potential to disturb prime and unique farmlands.	Slightly more soils could be subject to disturbance under this alternative than under the PA and Alternative C. Slightly fewer soils could be disturbed than for Alternative B. Little potential to disturb prime or unique farmland.	Slightly more soils could be subject to disturbance under this alternative than under the PA and other alternatives. Little potential to disturb prime or unique farmland.	Slightly more soils could be subject to disturbance under this alternative than under the PA. Slightly fewer soils could be disturbed than for the other alternatives. Little potential to disturb prime or unique farmland.

(1) Addresses only development and testing life-cycle phase

found no unavoidable, significant environmental impacts for the Proposed Action or any of the four Alternatives. The Proposed Action would involve research and development activities that would give the United States the capability to produce and deploy an integrated, comprehensive TMD system which would include a mix of Active and Passive Defenses, and Counterforce. Alternatives include 1) Improve Action Defense Only; 2) Improve Counterforce Only; 3) Improve Passive Defense Only; and 4) No Action (no new research, development, testing, production or basing).

Cumulative impacts of the BMD Program, including NMD and TMD activities, are evaluated. The BMD Program is expected to result in minimal long-term impacts to air quality and the upper atmosphere which do not violate any federal or state laws. Previous modeling studies performed for larger launch vehicles with aggressive launch schedules have concluded that such impacts are minimal. EMR cumulative impacts would also be expected to be minimal and within all applicable regulations. Impacts of testing would be localized, with only brief periods of EMR transmission.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES OF THE PREFERRED ACTION (EXISTING TECHNOLOGY READINESS PROGRAM)

Most activities would continue in existing facilities at government and contractor installations staffed and equipped to perform these functions. Therefore, disturbance to natural and cultural resources and impacts associated with these activities would be minimal and would not result in any new significant impacts. All activities would follow applicable regulations and established guidelines and management practices. These activities would generally occur within developed areas of existing installations or industrial parks. Any increased water demands could be readily met by existing supply systems, groundwater withdrawals, or alternative sources without significant environmental impacts.

Most activities would be staffed by existing personnel, although minor staff augmentation could be necessary at certain installations. Substantial increases in regional population, and the accompanying increase in demand for water, housing, and other resources, would be unlikely.

Small quantities of hazardous materials, such as rocket and missile propellants and industrial solvents, would be stored and handled. Routinely practiced measures typically outlined in spill prevention, control, and countermeasures plans for industrial facilities (including best management practices for handling hazardous materials) would prevent and/or mitigate accidental contamination of surface water and groundwater, soil, and other environmental resources. Routine stormwater management facilities are expected to prevent contamination of environmental media from runoff water, and routine erosion control practices typically outlined in soil erosion

and sediment control plans are expected to prevent sedimentation of surface waters.

Test-firing of GBIs and launching of rockets to carry GBI test targets and space-based element test components aloft would generate short-duration exhaust clouds and brief periods of loud noise on established test ranges. Effluents from similar activities have been shown to have only minimal long term impacts on lower atmosphere air quality, upper atmosphere ozone levels, surface water, and soil surrounding the site of generation. Noise from these activities would be within applicable regulations and at established missile test ranges.

Solid debris from test-fired GBIs, spent targets, and jettisoned rocket stages could fall on land and in surface water under missile trajectories. These trajectories would generally be over uninhabited desert or open ocean, where falling debris would not represent a public safety hazard or source of surface water contamination. Range recovery procedures would remove debris falling nearshore or into inland waters which might result in localized surface water contamination.

Most NMD electromagnetic radiation (EMR) generated by electric power lines, sensors, or communication systems would not adversely affect human health or wildlife, or interfere with electronic equipment. Procedures would be established to minimize effects on a site-by-site basis. Because this equipment would be oriented skyward, birds and other airborne fauna might be at particular risk. Ground personnel working in the immediate vicinity would be instructed to follow strict safety precautions to avoid EMR exposure. Ground fauna would be kept out of danger by fences if necessary.

COMPARISON OF ENVIRONMENTAL CONSEQUENCES FROM THE SYSTEM ACQUISITION ALTERNATIVES WITH THOSE FROM THE PREFERRED ACTION

Although the development and testing phase of the System Acquisition Alternatives involves an increased scale of activity relative to the Preferred Action, the overall conclusions concerning environmental consequences would not be different. There could be a greater number of activities associated with new construction, but the areas of disturbance would still be small and generally within existing industrial complexes. Staff augmentation and other resource demands, while possibly higher, would still be minimal. Likewise, while the number and types of rocket launches and test-firing activities could increase, noise disturbance and hazards from falling debris would still be minor. The same measures to prevent accidental contamination of various environmental resources would be equally effective.

COMPARISON OF ENVIRONMENTAL CONSEQUENCES FROM RESEARCH, DEVELOPMENT, AND TESTING OF THE SYSTEM ACQUISITION ALTERNATIVES

The overall conclusions with respect to environmental consequences do not differ between the three System Acquisition Alternatives, even though the type, number, frequency and duration of activities in the development and testing phases of each of the System Acquisition Alternatives could differ. The overall effects from exhaust clouds and falling debris would be minimal and within existing regulations, even though the numbers of specific launch and test-firing activities could differ between alternatives.

COMPARISON OF ENVIRONMENTAL CONSEQUENCES AMONG LATER LIFE-CYCLE PHASES OF SYSTEM ACQUISITION ALTERNATIVES

The All Ground-Based System Acquisition Alternative would require basing a larger number of ground-based facilities than the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. Greater land areas and more buildings would be used under the All Ground-Based System Acquisition Alternative, with a corresponding increase in potential for soil disturbance and encroachment into natural habitats. There would also be a greater potential for inducing regional population increases (and associated effects) by establishing bases for ground-based elements in isolated areas.

The Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative would also involve more ground-based elements, but not as many as the All Ground-Based System Acquisition Alternative.

PUBLIC COMMENT AND HEARING PROCESS

In compliance with NEPA, BMDO encouraged public participation in the environmental impact process by making the Draft PEIS available for public review and comment from April 15 through May 31, 1994. Public hearings were held in Santa Barbara, California, on May 10, 1994, and in Washington, D.C., on May 12, 1994.

An advertisement announcing the public hearings appeared in both national and regional newspapers, and in the *Federal Register*. The advertisement appeared in *USA Today*, the *Los Angeles Times*, and the *Washington Post* prior to the hearings. Public service announcements were submitted to both the Los Angeles, California, and Washington, D.C., areas on two separate occasions. Press conferences were also held in both cities. A copy of the Notice of Availability (NOA) was mailed along with the Draft PEIS document to all those who expressed an interest in receiving information on the program. The NOA offered an invitation to provide comments within the

comments within the specified comment period dates; announced hearing locations, dates, and times; listed the comment mail address; and identified a toll-free 800 number for both verbal and hearing-impaired comments/requests.

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Chapter 1

Need and Purpose for Ballistic Missile Defense Capability

1.0 PURPOSE AND NEED FOR A BALLISTIC MISSILE DEFENSE CAPABILITY

This chapter presents the purpose and need for developing a ballistic missile defense (BMD) capability. The purpose of a BMD system is discussed, including a history of ballistic missile defense and an overview of the BMD operational concepts and elements. A discussion of the current status of ballistic missile proliferation, the major factor in the need for a BMD capability, is then presented. The scope of this Programmatic Environmental Impact Statement (PEIS) is then discussed. Finally, the scoping process for this PEIS is summarized. A list of acronyms/abbreviations and a glossary of terms used in this PEIS are included in Appendices A and B.

1.1 PURPOSE OF A BALLISTIC MISSILE DEFENSE CAPABILITY

This section presents the purpose of a BMD capability based upon existing and perceived future threats. The purpose of the BMD Program is to develop a defense of the United States, expeditionary elements of the U.S. Armed Forces deployed abroad, and U.S. friends and allies against limited (non-massive) ballistic missile attack. This section includes a history of the BMD Program followed by a short description of BMD concepts and elements.

1.1.1 HISTORY OF THE BALLISTIC MISSILE DEFENSE PROGRAM

Following World War II, the United States and the former Union of Soviet Socialist Republics (USSR) entered into an arms race that continued into the early 1990s. During the height of the arms race, the United States relied heavily on a national defense strategy of mutually assured destruction to keep conflicts from escalating beyond conventional warfare to nuclear war. In 1955, the United States began to evaluate ways to protect against ballistic missile attack. This study led to the development of the Nike-Zeus System, which accomplished the first successful intercept of a target intercontinental ballistic missile (ICBM) in 1962.

In 1972, the United States and USSR signed the Anti-Ballistic Missile (ABM) Treaty, which limits the development, testing, and deployment of ABM systems and components. A 1974 amendment to the treaty further limits ABM defense deployment to one site at either an ICBM field or near the respective national capital. In 1975, the Safeguard System, the only U.S. ABM system ever deployed, was activated in North Dakota. Safeguard operated only until 1976. At present, the United States has no operational ABM system.

Research into ABM systems and component development continued through 1983. At that time, then President Reagan called for an intensive research program to determine the feasibility of developing and deploying a highly effective missile defense system. The Strategic Defense Initiative Organization (SDIO) was established within the Department of Defense (DoD) to manage and direct the research and testing of advanced technologies applicable to the development of a strategic missile defense system. These research and testing activities were collectively known as the Strategic Defense Initiative (SDI). Initially, the main purpose of SDI research concerned protecting the United States from weapons of mass destruction involving multiple ICBM strikes.

After the conflict in the Persian Gulf and the breakup of the USSR, SDIO was refocused to emphasize protecting theater (i.e., outside the United States) operations and defending the United States against limited missile attacks (200 warheads or less). In January 1991, then President Bush described the need to acquire and deploy a BMD system to protect not only the United States but also our forces overseas and our friends and allies. Subsequently, Congress provided guidance and direction to DoD to redirect research and development for protection against any ballistic missiles, regardless of their source.

The Missile Defense Act (MDA), enacted as part of the National Defense Authorization Act of 1992 (Public Law 92-190), established goals for theater and national missile defenses. It directed DoD to develop a Theater Missile Defense (TMD) system for possible deployment in the mid-1990s, and a limited National Missile Defense (NMD) system for possible deployment at an initial, ABM Treaty–compliant site by 1996 or as soon as appropriate technology would allow. In July 1992, then Defense Secretary Cheney outlined the plan for development and deployment of theater and national missile defenses. In passing the Fiscal Year (FY) 1993 Defense Authorization Act (Public Law 92-484), Congress deleted the dates contained in the MDA. In the conference report accompanying this Act, Congress endorsed a plan to deploy a limited NMD system by 2002.

Early in 1993, the Clinton administration again refocused SDIO. Defense Secretary Aspin signed a memo stating that the NMD Program should support system deployment beginning no earlier than 2002. In May 1993, he announced the conversion of SDIO into the Ballistic Missile Defense Organization (BMDO). The term "ballistic missile defense" is used in general reference to defenses against missiles, whether ballistic or continuously propelled, including both TMD and the limited NMD prescribed by the Clinton and Bush administrations and described in the MDA as modified.

In October 1993, DoD completed the *Report on the Bottom-Up Review* (U.S. DoD, 1993). The purpose of the review was to define the strategies, force structures, modernization programs, industrial base, and infrastructure

needed for restructuring all programs within DoD. With respect to BMD, the review examined a range of program options that emphasized TMD, NMD, both, or neither. The review proposed to emphasize and proceed with the acquisition of a robust TMD program combined with the further development, but not the acquisition, of a more limited NMD program.

1.1.2 CURRENT OVERVIEW OF THE BALLISTIC MISSILE DEFENSE PROGRAM

This section provides an overview of the BMD Program. Descriptions of its two main segments, TMD and NMD, are also included. The two segments of the BMD Program would have common or shared technologies. Advanced technology development of sensor systems (systems of instruments that detect energy emitted or reflected from objects) would continue in support of TMD. These technology advances would also be capable of supporting the NMD mission. Additionally, prior investments in missile defense components and technologies, as well as TMD interceptor technology efforts, would provide a development path for NMD ground-based interceptor (GBI) technology. The common use of shared technologies between the segments would provide both short- and long-term cost and resource savings.

1.1.2.1 Ballistic Missile Defense Program

The United States has been engaged in BMD activities since the advent of the ICBM. In the early 1970s, the United States deployed an ABM system consisting of a radar-guided, nuclear-tipped interceptor near Grand Forks, North Dakota. However, the system was deactivated shortly after deployment. Current BMD research and development began in 1983 under the SDI and has focused on non-nuclear interceptor technologies. This program has undergone several revisions and is now being managed in accordance with the results of the October 1993 DoD Bottom-Up Review (U.S. DoD, 1993). The current BMD mission is to defend the United States against limited attacks of ballistic missiles, and to defend expeditionary elements of the U.S. Armed Forces deployed abroad and U.S. friends and allies against theater ballistic missiles.

As discussed in Section 1.3.1 of this PEIS, separate PEISs are being prepared for each BMD segment. The scope of the TMD PEIS, released in September 1993 (BMDO, 1993), was to address the environmental effects of the theater defense mission of BMD. The scope of this PEIS is to address the environmental effects of the entire BMD Program. This is accomplished by addressing in particular the environmental effects of NMD and incorporating the TMD PEIS by reference. This PEIS includes a discussion of the cumulative environmental impacts of the entire BMD Program in Section 4.15.

1.1.2.2 Theater Missile Defense

Our forces stationed overseas and our allies experienced missile attacks during the Persian Gulf War. Similar missiles are potential threats to our forces, allies, and friends in many parts of the world (BMDO, 1993). TMD would give the United States the ability to defend its Armed Forces deployed abroad, and its friends and allies, against theater missile attack in any theater of operations. A theater missile is defined as any missile (e.g., ballistic, cruise, or air-to-surface guided missile) directed against a target in an area of operations outside the United States. The purpose of TMD is to prevent or counter the launch of theater missiles against U.S. forces and allies, protect U.S. forces and allies from theater missiles launched against them, reduce the probability of and minimize the effects of damage caused by such an attack, and manage a coordinated response to a theater missile attack and integrate it with other combat operations.

TMD consists of three components: (1) a counterforce to destroy an enemy's ability to launch missiles; (2) a passive defense to evade detection and otherwise enhance survival from missile attack; and (3) an active defense to destroy enemy missiles in flight. The specific mix of these components will be developed as needs, feasibility, lethality, mobility, technical maturity, and costs are defined and analyzed. Supporting each of the components individually, and providing a means of managing and integrating the overall TMD system, is a network of Command, Control, Communications, and Intelligence elements.

TMD, though a part of BMD, has independent utility and is evaluated in its own PEIS. Additional details about the proposed TMD program, its alternatives, and potential environmental impacts may be found in the *Final Theater Missile Defense Programmatic Life-Cycle Environmental Impact Statement* prepared by the U.S. Army Space and Strategic Defense Command (BMDO, 1993). The TMD PEIS is incorporated by reference into this BMD PEIS.

1.1.2.3 National Missile Defense

The mission of NMD is to defend the United States from an intentional, accidental, or unauthorized limited ballistic missile attack (SDIO, 1992). Recent BMD research and development has considered five major element types for the NMD mission: Ground-Based Sensors (GBS, currently radar); GBI; Space-Based Sensors (SBS); Space-Based Interceptors (SBI); and a Battle Management/Command, Control, and Communications (BM/C3) element (Figure 1-1).

Should a decision be made to deploy a limited NMD system at a single site, this site could include the following mix of elements: GBIs, fixed GBS (probably radar), and BM/C3, with supporting SBS. To provide

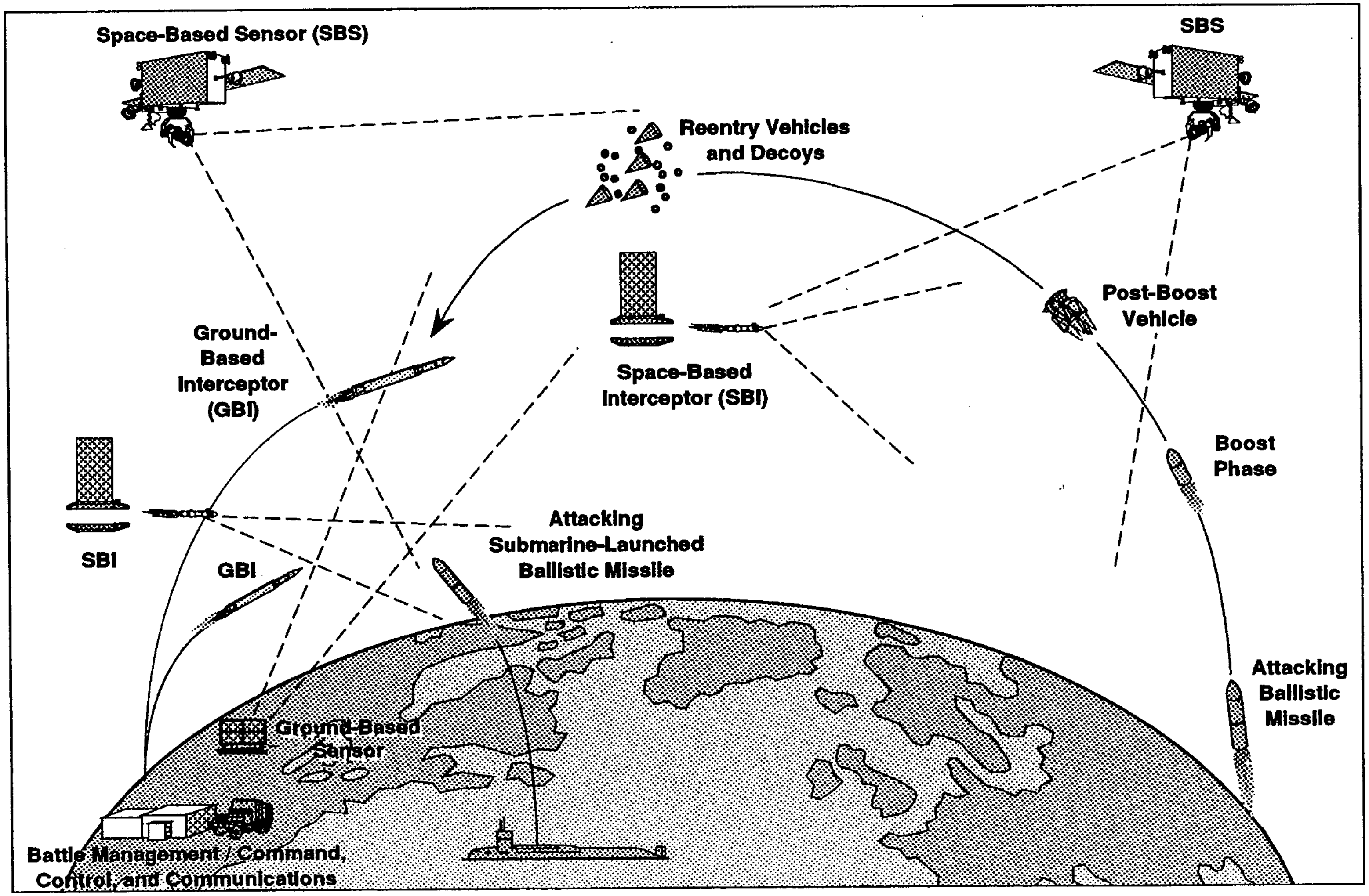

Figure 1-1. The Five Element Types Considered for the NMD Mission

comprehensive protection against limited strikes for the entire United States, other sites might be added. Two of these sites, which could be located in Alaska and Hawaii, might have only interceptors. Provision of any NMD system other than that agreed upon in the ABM Treaty would require modification of the treaty. Under the current ABM Treaty, only one ABM system is permitted, to be located either in the vicinity of an ICBM site or in the National Capital region.

1.1.3 BALLISTIC MISSILE DEFENSE CONCEPTS AND ELEMENTS

The effectiveness of a missile defense system is measured by its ability to prevent incoming missiles launched deliberately or accidentally from reaching their targets. To protect these targets from an attack of this kind, a missile defense system must perform the following basic functions:

- Detection - rapid and reliable warning of a missile.
- Tracking and Identification - the capability to track, identify, and discriminate targets from other objects associated with a missile attack.
- Battle Management and Communications - the capability to process data from sensors into useful information so that command personnel can make informed decisions to take defensive measures.
- Interception - the capability to destroy an attacking missile in flight.

The most effective BMD system would be based on a multilayered defense concept. The multilayered concept means that it would be possible to detect, track, and intercept theater and strategic missiles at any stage of a missile's trajectory, including the two earliest stages, boost and ascent. This capability would increase the opportunity of destroying attacking missiles. A multilayered BMD system may employ space-based and ground-based components to track and intercept attacking missiles in their various stages of flight. Ground-based defenses may not be able to engage long-range missiles until more than half of their flight is over. SBSs and SBIs, on the other hand, could identify, track, and engage attacking missiles during earlier flight stages. GBIs are essential for defending against reentry vehicles that survive space-based intercept attempts and against short-range missiles that cannot be effectively intercepted from space.

The BMD concept of operation calls for sensor systems to transmit launched missile data to the command center. Based on estimates of the missile's initial trajectory, a determination is made whether to activate a defense. Sensors continue to track incoming missiles to support the launch of

interceptors. If necessary, the command center commits an appropriate interceptor, whether TMD or NMD, based on the trajectory of the incoming missiles and the location of the interceptor. When an interceptor nears its target, on-board sensors acquire the target, discriminate it from other objects, and support homing for intercept. Sensor systems then provide the command center with data on whether the target has been destroyed.

1.2 NEED FOR A BALLISTIC MISSILE DEFENSE CAPABILITY

The need for further research and development of a BMD capability comes from the threat posed by the global proliferation of missile technology and the accompanying production and development of weapons of mass destruction. This threat is created by the relative ease with which countries can acquire these technologies and weapons, as well as by the presence of thousands of nuclear, biological, and chemical weapons in the Commonwealth of Independent States established following the breakup of the USSR.

Following World War II, the Cold War competition between the former USSR and the United States spawned a missile development race that was followed by missile development some 15 to 20 years later in China, France, and the United Kingdom (System Planning Corporation, 1992). Since then, missiles capable of carrying weapons of mass destruction have been obtained and developed by a growing number of nations. The wide range of sources for missile components has shortened the development time for countries that desire these capabilities.

Many of the governments which are obtaining or developing weapons of mass destruction are unstable, which makes it difficult to predict their intentions. At issue are whether these governments are willing to use these weapons and if they can even maintain control over them. This poses the threat that relatively minor conflicts could become broader in scope and more dangerous than in the past.

While the threat of ballistic missile attack is not new, today's geopolitical conditions demand a different response. In the past, the United States relied on a strategy of nuclear deterrence. This strategy was based on the belief that a U.S. capability to retaliate with offensive nuclear weapons would deter any rational aggressor from using weapons of mass destruction against the United States. Nuclear deterrence was an effective strategy in response to a single, concentrated threat (i.e., the former USSR).

Today's multiple and geographically separated threats limit the effectiveness of a strategy based solely on nuclear deterrence. The threat scenarios considered most likely are limited missile strikes which might occur by accident, by a rogue commander operating without authorization, or as part of a deliberate attack. A response to these threats must work toward both

a reduction in these threats and development of a defense against missile attack.

The United States has been involved in efforts to reduce the threat posed by the proliferation of weapons of mass destruction. In the 1980s, the Missile Technology Control Regime (MTCR) was established to provide export control agreements among seven leading industrial nations (System Planning Corporation, 1992). Since that time, 16 other nations have joined the MTCR. The MTCR has impeded proliferation to some extent but has not eliminated the ability of nations to obtain advanced weapons technology. President Clinton has reaffirmed the high priority given by the United States of reducing both the proliferation of weapons of mass destruction and ballistic missiles (U.S. Newswire, 1993).

Approximately 40 nations currently have at least a short-range missile capability (George C. Marshall Institute, 1991; System Planning Corporation, 1992; Institute for Defense and Disarmament Studies, 1993). The United States, its forces overseas, and its friends and allies currently have minimal protection against ballistic missile attack. The PATRIOT (Phased Array Tracking to Intercept of Target) is the only missile defense system available at this time; it provides limited defense to small areas within a theater of operations against unsophisticated short-range missiles.

The need for developing a BMD capability is to provide for a defense against potential threats posed by the proliferation of ballistic missiles, particularly by irresponsible leaders or nations. This can be accomplished by developing the capability to deploy a defensive system that would ensure that no political or military advantage could be gained by threatening to use or actually launching ballistic missiles against the United States, its forces overseas, or its friends and allies.

Currently no nation considered to have the intent to attack the United States has the capability to do so. The research and development activities described in this PEIS would provide the capability to produce and deploy an NMD system if a threat to the United States is identified in the future.

1.3 SCOPE OF THIS PROGRAMMATIC EIS

1.3.1 APPROACH TO NEPA COMPLIANCE

The DoD established an Environmental Impact Analysis Process (EIAP) framework for integrating environmental considerations into its decision-making as required by the National Environmental Policy Act (NEPA). The EIAP framework established a plan for the timing and scope of environmental impact analysis documentation to ensure that adequate environmental planning information is available to support decision-making.

A variety of environmental analysis documents have already been prepared to support BMDO activities. Previous NEPA documentation supported the transition of the BMD research program from earlier stages into more technology-specific research. In 1987, SDIO prepared a number of Environmental Assessments (EAs) which analyzed the potential effects of the boost surveillance and tracking system, exoatmospheric (outside the earth's atmosphere) reentry vehicle interceptor subsystem, ground-based surveillance and tracking system, SBI, space-based surveillance and tracking system elements, and BM/C3. BMDO has prepared various test-specific EAs and EISs (e.g., the Strategic Target Systems Environmental Impact Statement [EIS]) and EAs and EISs for several national test ranges and research facilities (e.g., the U.S. Army Kwajalein Atoll EIS). EAs and EISs will be prepared as required for future testing. Technology-specific EAs are complete for individual technologies.

The BMDO believes the requirements of a BMD system, the definition and components of the feasible technologies, and the resources required are now sufficiently understood to allow programmatic analyses of environmental impacts. The BMDO decided to prepare two PEISs to analyze its ongoing programs. This PEIS, sponsored by BMDO and prepared by the Air Force Center for Environmental Excellence, addresses the potential environmental impacts of BMD program development (including both the NMD and TMD programs) but specifically focuses on the research and development of NMD elements. The TMD PEIS, also sponsored by BMDO and prepared by one of BMDO's executing agents, the U.S. Army Space and Strategic Defense Command, addresses the acquisition life-cycle environmental impacts for the TMD program. The impacts of the TMD Program are summarized in the discussion of BMD cumulative impacts in Section 4.15 of this PEIS.

This document primarily addresses NMD research, testing, and development activities. As specific activities (and their locations) are identified, some may potentially cause environmental impacts. Additional environmental documentation beyond this PEIS may be required to address specific testing activities. Should a decision be considered to move into production, siting, basing, and operation of an NMD system, additional environmental documentation would be required.

1.3.2 THE BMD PROGRAMMATIC EIS

The primary focus of this BMD PEIS is to evaluate the environmental impacts of alternatives that would provide the United States with the capability to produce and deploy an NMD system at some point in the future, should it become necessary. A secondary objective is to consider the environmental impacts of the entire BMD Program by discussing the cumulative impacts of both the NMD and TMD segments. Alternatives were considered based on cost and operational effectiveness of available

technologies. The alternatives include some combination of ground-based and space-based elements (sensors, interceptors, and system management). Space-based elements would provide for a layered defense and enhance the effectiveness of ground-based system elements.

This document evaluates the activities of the Preferred Action and several System Acquisition Alternatives. The Preferred Action, continuation of ongoing NMD activities currently part of a Technology Readiness Program, is the No Action Alternative in this PEIS. Activities under the Preferred Action are ongoing programs initiated under existing Congressional direction. The System Acquisition Alternatives are alternatives to the Preferred Action that involve more intensive research, development, and system-level testing as part of a program to acquire a specific defense system. This PEIS supports decisions on research, development, and testing activities by analyzing the potential environmental impacts of these alternatives, and serves as the foundation from which future environmental documentation can be prepared, if needed.

Unlike the Preferred Action, the System Acquisition Alternatives have defined system architectures and descriptions of the DoD system acquisition life-cycle phases. For these alternatives, the PEIS discusses potential environmental impacts of NMD activities beyond development and testing. These activities, which are included in this PEIS for information and planning purposes only, include system production; basing (deployment); operations and maintenance; and eventual decommissioning of facilities. The potential impacts from these activities are discussed in order to provide DoD decision makers with information on potential future impacts related to system acquisition. If required by future world events, the NMD system would enter the DoD System Acquisition process. Additionally, future environmental documentation would be prepared, as required.

1.3.3 THE TMD PROGRAMMATIC EIS

The TMD PEIS, completed in September 1993, is a life-cycle document with a focus on system alternatives for theater missile defense needs (BMDO, 1993). It evaluates the environmental impacts of conducting research and development activities to give the United States a capability to produce and deploy a TMD system designed to defend against both short- and long-range theater missile attacks. The TMD system is transportable in order to defend U.S. deployed forces and U.S. friends and allies overseas.

The TMD PEIS supports the research, development, and testing of TMD systems but also considers the later life-cycles of the system: production, basing and decommissioning. It supports system acquisition milestone decisions involving the selection of alternatives to provide TMD capabilities. As with the BMD PEIS, the TMD PEIS will serve as the foundation from which future environmental documentation may be prepared, if needed.

1.3.4 FUTURE ENVIRONMENTAL DOCUMENTATION

It is anticipated that additional environmental documentation will be prepared for future activities in the BMD Program. Impacts can be evaluated more specifically as sites are proposed and evaluated for testing, production, and deployment. For example, future documentation may evaluate NMD siting or TMD basing and related operations impacts, including construction at specific locations. These environmental analyses will tier from the BMD and TMD PEISs.

BMDO will continue to ensure that environmental considerations are part of the decision-making process of all BMD research and test activities on a test and site-specific basis throughout the program. For example, the need to update the facility-wide documentation for U.S. Army Kwajalein Atoll was identified while preparing the 1987 EAs. An EIS was then prepared addressing the cumulative environmental impacts of ongoing test activities at the installation. Later, changes to test programs required an update, and a Final Supplemental EIS was published in December 1993.

1.3.5 FEDERAL, STATE, AND REGIONAL RELATIONSHIPS

Certain aspects of the alternatives, including the Preferred Action, would require a variety of NMD actions. Some activities would require permits, approvals, and consultations with other federal agencies. Permits for discharges to air and water and disposal of solid and hazardous waste would be obtained in accordance with federal laws. A list of potential federal rules, regulations, and statutes is presented in Appendix G. Actions undertaken in connection with the Preferred Action and alternatives would meet all regional, state, and local laws and regulations.

1.3.6 INTERNATIONAL AGREEMENTS

1.3.6.1 The Anti-Ballistic Missile Treaty

The 1972 ABM Treaty addresses the development, testing, and deployment of ABM systems and components. Neither the U.S. nor the Soviet delegation to the Strategic Arms Limitation Talks (SALT I) negotiations chose to place limitations on research, and the ABM Treaty makes no attempt to do so. Research includes, but is not limited to, conceptual design and laboratory testing. Development follows research and precedes full-scale system and component testing. Development of a weapon system is usually associated with the construction and prototype testing of the system or its major components. The ABM Treaty prohibits the development of sea-, air-, space- or mobile land-based ABM systems, or components of such systems, when a prototype of such a system, or its components, enters the field-testing stage. These prohibitions are due

largely to the inability to effectively verify treaty provisions by technical means.

The ABM Treaty regulates the development, testing, and deployment of ABM systems whose components are defined in the Treaty as consisting of ABM interceptor missiles, ABM launchers, and ABM radars. ABM systems based on other physical principles and including components capable of substituting for ABM interceptor missiles, launchers, or radars are addressed only in Agreed Statement D of the ABM Treaty. This Agreed Statement provides that specific limitations on such systems and their components are subject to discussion in accordance with Articles XIII and XIV of the Treaty. The BMDO Program will continue to be conducted in a manner that complies with all U.S. obligations under the ABM Treaty.

1.3.6.2 Existing Treaty Compliance Process

DoD has an effective treaty compliance process (established with the SALT I agreements in 1972) under which key offices in DoD are responsible for overseeing BMD compliance with all U.S. arms control agreements. Under this process, BMDO and DoD components ensure that the implementing program offices adhere to DoD compliance directives and seek guidance from offices charged with oversight responsibility.

Specific responsibilities are assigned by DoD Directive 2060.1, *Implementation of, and Compliance With, Arms Control Agreements.* DoD must ensure that all DoD programs are in compliance with U.S. arms control agreements. The Service secretaries, the Chairman of the Joint Chiefs of Staff, and agency directors must ensure the internal compliance of their respective organizations. The DoD General Counsel provides advice and assistance with respect to the implementation of the compliance process and interpretation of arms control agreements.

DoD Directive 2060.1 also establishes procedures for ensuring the continued compliance of all DoD programs with existing arms control agreements. Under these procedures, questions of interpretation of specific agreements are to be referred to DoD for resolution on a case-by-case basis. No project or program which reasonably raises a compliance issue can enter into the testing, prototype construction, or deployment phase without prior clearance from DoD. If a compliance issue is in doubt, DoD approval must be sought. In consultation with the Office of the DoD General Counsel, the Office of the Assistant Secretary of Defense for International Security Policy, and the Joint Staff, DoD applies the provisions of the agreements as appropriate. DoD offices, including BMDO, certify internal compliance periodically and establish internal procedures and offices to monitor and ensure internal compliance.

In 1985, the United States began discussions with Allied governments regarding technical cooperation on SDI research. In 1992, the United States concluded bilateral BMD research memoranda of understanding with the United Kingdom, Germany, Israel, Italy, and Japan. All such agreements will be implemented consistently with U.S. international obligations, including the ABM Treaty. The United States has established guidelines to ensure that all exchanges of data and research activities are conducted in full compliance with the ABM Treaty obligation not to transfer to other nations ABM systems or components limited by the Treaty, or to provide technical descriptions or blueprints especially worked out for the construction of such systems or components. All BMD field tests must be approved for ABM Treaty compliance through the DoD compliance review process.

1.3.7 PUBLIC INVOLVEMENT

Public involvement promotes understanding, education, and information exchange between the public and BMDO. Public announcements must be scheduled in compliance with the Council on Environmental Quality NEPA regulations as outlined in 40 CFR 1500-1508, and DoD Directive 6050.1, *Environmental Effects in the United States of DoD Actions*. Notification must be made to the appropriate government agencies and media within required time constraints. BMDO must prepare public announcements, including notices of public meetings or hearings, notices of the availability of Draft and Final PEIS, and notices of any Record of Decision (ROD).

BMDO held public hearings on the Draft PEIS at two locations in the United States. BMDO promoted the public comment process in an efficient, effective manner and applied a consistent analytical process to all comments received. Equal consideration has been given to all comments received during the public comment period, whether presented verbally or in writing. All comments were included in this Final PEIS. The Final PEIS has been modified, as appropriate, to reflect comments received.

1.3.8 DECISION(S) TO BE MADE

The Director of BMDO will review the PEIS and take into account the comments from the public, and direction from Congress and the Executive Branch. Within the constraints posed by funding limitations and policy directives, the range of decision alternatives includes proceeding with the Preferred Action, selecting one of the System Acquisition Alternatives, deferring the selection to a later date, or making no selection at all. The PEIS could support multiple decisions as world conditions or security needs or policies change.

Should the Preferred Action be selected, BMDO would continue with Technology Readiness Program activities. Under the Preferred Action, BMD system elements, including space-based and ground-based sensors, ground-

based interceptors, space-based and ground-based communication systems, and a ground-based command and control system, would undergo further research, testing, and evaluation.

In the event a decision is made to proceed with one of the System Acquisition Alternatives, test and development activities of specific elements would be conducted as part of an acquisition process to provide the United States with the capability to produce and deploy an NMD system.

Regardless of the decision on NMD activities, TMD research and development activities that would give the United States a capability to produce and deploy an integrated, comprehensive TMD system would continue. This TMD system would include a mix of Active Defense, Counterforce, and Passive Defense components as proposed in the TMD PEIS (BMDO, 1993).

1.3.9 RECORD OF DECISION

After the publication of the Final PEIS, and following a minimum 30-day period after publication of the Final PEIS Notice of Availability in the *Federal Register*, the BMDO decision maker may choose from the alternatives analyzed in the PEIS the action that is to be taken. The choice may also be a permutation of the alternatives, deferred selection, or no selection at all. The choice selected may not necessarily be either the environmentally preferable alternative or BMDO's Preferred Action as identified in the Final PEIS.

The ROD will include a review of the Preferred Action and alternatives considered in the Final PEIS, the rationale behind the decision, and a detailed discussion of it. This discussion will summarize the significant environmental impacts of the selected alternative, including an overview of potential future impacts. It will discuss any proposed mitigations for potentially significant impacts and will provide a discussion of any mitigative measures not accepted by the decision maker. Should BMDO propose monitoring of any activities, details of these plans will be discussed.

The ROD will identify other considerations which were taken into account prior to the decision. These may include national security, DoD policy, and international treaties and agreements. The ROD will be published in the *Federal Register*. As noted above, the PEIS may support more than one decision and ROD as events and security needs dictate.

1.4 SUMMARY OF SCOPING PROCESS

The scoping process is used to determine the range of issues to be addressed and to identify the significant issues related to a proposal. The scoping period for the BMD PEIS began on February 4, 1992 and ended on March 6, 1992. During this period, members of the general public were notified of the purpose and intent of the PEIS and invited to express their concerns about potential environmental issues associated with the implementation of this program. Public hearings were held in Washington, DC, and Los Angeles, California, on February 25 and February 27, 1992, respectively. Three toll-free telephone numbers were made available to the public, and a post office box was set up to receive written comments.

During the scoping process, a wide range of issues, both environmentally and non-environmentally related, were identified. Each comment was placed into an issue category, of which 10 were identified. Categories are summarized below in order of the volume of comments received. Table 1-1 presents the comment categories, specific issues, and the number of comments received.

The most frequently raised scoping issues were those placed under the category of *Policy*. These comments primarily addressed political considerations and therefore fall outside the scope of the PEIS. Respondents questioned the need for the BMD system, given the changing global political climate. Comments were made questioning budget allocations, or the allocation of budget dollars to BMD, given other, more pressing needs. Other concerns raised which fall under the general Policy category are: miscellaneous political issues; procedural problems associated with the scoping process and NEPA EIS requirements; dangers associated with nuclear power/nuclear weapons; the need for greater efforts toward arms reduction; possible contravention of the ABM Treaty; the classification of information contained in DoD EAs and EISs; budget allocation in foreign countries; and military base cleanup costs.

The next most frequent comment type was in the general category of *Other*. Statements categorized as "no issue" were typically requests for information, while comments categorized as "no specific issue" were typically general statements of concern about potential adverse environmental impacts being caused by BMD.

The third most frequently raised issues were categorized as *Program Issues*. Issue statements placed under this category included the following: stratospheric ozone depletion caused by BMD; the creation of orbital debris caused by BMD; environmental impacts associated with the mining of strategic resources needed for the construction and operation of BMD; issues related to the description of the Preferred Action and Alternatives;

Table 1-1. Scoping Comments by Category for the BMD PEIS (Sheet 1 of 2)

General Issue Category	Comment	Number of Comments
Policy	Need for BMD system	46
	Budget allocations	35
	Miscellaneous political issues	31
	Problems with scoping and NEPA EIS process	21
	Dangers associated with nuclear power/nuclear weapons	11
	Need for greater efforts toward arms reduction	5
	Possible contravention of the ABM Treaty	5
	Classification of information found in DoD EAs and EISs	3
	Budget allocation in foreign countries	1
	Military base cleanup costs	1
	Total	**159**
Other	Information requests (no issue raised)	43
	General concerns regarding potential environmental impacts (no specific issue)	42
	Total	**85**
Program Issues	Stratospheric ozone depletion	11
	Creation of orbital debris	9
	Environmental impacts of mining strategic resources for construction and operation of BMD	7
	Issues related to Preferred Action and Alternatives descriptions	3
	The effect of BMD activities on global warming	3
	Environmental impacts due to operation and maintenance of system	3
	Environmental impacts from decommissioning activities	1
	Need for site-specific analysis of the system	1
	Inherent weaknesses in the PEIS process	1
	Need for a life cycle EIS of the system	1
	Total	**40**
Hazardous and Radioactive Materials and Waste	General concerns about radioactive materials and wastes	24
	Environmental effects of uranium mining	1
	Ionizing radiation associated with BMD activities	1
	Total	**26**

Table 1-1. Scoping Comments by Category for the BMD PEIS (Sheet 2 of 2)

General Issue Category	Comment	Number of Comments
Natural Resources	Air pollution resulting from BMD activities	8
	Water pollution resulting from BMD activities	6
	Soil pollution resulting from BMD activities	4
	Adverse biological resource impacts due to BMD activities	3
	Possible threat by BMD to ecologically sensitive areas	3
	Total	**24**
Alternatives	Alternative missile defense systems to BMD	7
	Alternative siting and basing locations	6
	Support of Preferred Action	3
	Total	**16**
Technologies	Concerns regarding the technological feasibility of BMD	5
	General opposition to space-based weapons	5
	Concern about space-based sensors	1
	Proposal to use cleaner alternative fuels under BMD	1
	Total	**12**
Safety	General concern about possible public health risks	8
	Concern about risk to public health due to launch accidents	2
	Total	**10**
General Impacts	Concern about cumulative impacts of BMD on environment	5
	Concern about energy consumption associated with BMD	2
	Total	**7**
Non-Ionizing Radiation	Requests for further study of the effects of non-ionizing radiation associated with BMD	2
	Total	**2**

the effect of BMD on global climate change; environmental impacts associated with the operations and maintenance of the system; environmental impacts associated with the decommissioning of BMD; the need for site-specific analysis of the system; inherent weaknesses in the PEIS process; and the need for an EIS which assesses the system throughout its life-cycle.

The general category of *Hazardous and Radioactive Materials and Waste* contained the next most often cited issues. General statements of concern were made about hazardous and radioactive materials and waste, along with statements of concern about the environmental effects of uranium mining and ionizing radiation associated with BMD.

Natural Resources issues were the next most often cited category. Statements of concern addressed the following issues: air pollution caused by the launching, siting, and testing of BMD; water pollution caused by the launching, siting, and testing of BMD; soil pollution caused by the launching, siting, and testing of BMD; possible adverse impacts on biological resources caused by BMD; and possible threat to ecologically sensitive areas caused by the testing and siting of BMD.

Statements which identified alternatives to the Preferred Action and the BMD Program were the next most often mentioned; they are categorized under *Alternatives*. Statements were made proposing alternative missile defense systems to BMD, and alternative siting and basing locations. Other statements supported the Preferred Action.

Technological issues relating to BMD were the next most often cited; these are categorized as *Technologies*. Under this category, statements of concern were made questioning the technological feasibility of BMD. Some statements expressed general opposition to space-based weapons. Space-based sensors and the use of cleaner alternative fuels were also cited.

Comments relating to safety issues were categorized as *Safety*. Statements were made expressing general concern about possible public health risks associated with BMD. Statements of concern were also made about launch accidents posing a public health risk.

Comments addressing the general long-term environmental impacts of BMD were categorized as *General Impacts*. Statements of concern were made about the cumulative impacts of BMD on the natural environment, and energy consumption related to BMD.

Finally, statements of concern were made requesting that the effects of *Non-Ionizing Radiation* associated with BMD be studied further. One statement of concern requested that the PEIS include an analysis of the effects of electromagnetic radiation.

Chapter 1 References

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Chapter 2

Description of Alternatives

2.0 DESCRIPTION OF ALTERNATIVES

This chapter describes the activities involved in the program to develop a ballistic missile defense (BMD) capability. The chapter includes an introduction that provides a brief background of the BMD Program and some BMD and Department of Defense (DoD) concepts discussed in the descriptions of the alternatives. An overview of the Preferred Action is followed by descriptions of the various element activities. Alternatives to the Preferred Action are then discussed. Finally, alternatives considered but eliminated from detailed study and a comparison of the alternatives are provided.

2.1 INTRODUCTION

This section provides an introduction to assist in understanding the descriptions of the Preferred Action and the System Acquisition Alternatives that follow. A description of the segments within the overall BMD Program is provided, followed by a discussion of the National Missile Defense (NMD) Technology Readiness Program and the DoD System Acquisition process. A description of the NMD Program elements is then provided. Finally, brief summary descriptions of the Preferred Action and the System Acquisition Alternatives are included. Regardless of the decision on NMD activities, Theater Missile Defense (TMD) research and development activities that would give the United States a capability to produce and deploy an integrated, comprehensive TMD system would continue.

2.1.1 TECHNOLOGY READINESS AND SYSTEM ACQUISITION

This section details the concepts of technology readiness and system acquisition as related to the NMD Program. The NMD Technology Readiness Program, the Preferred Action in this PEIS, is a focused approach to technology development. Unlike the TMD Program (BMDO, 1993), the NMD Technology Readiness Program is not part of the DoD system acquisition process, which is a structured strategy of phases and milestones governing major defense system procurement. Alternatives to this program are termed System Acquisition Alternatives. The decision to produce and deploy an NMD system would be considered a separate action and would require supplemental and/or new environmental analyses. However, this document could support a decision to convert the NMD Technology Readiness Program into one of the System Acquisition Alternatives. Regardless of the decision on NMD activities, TMD research and development activities that would give the United States a capability to produce and deploy an integrated, comprehensive TMD system would continue.

2.1.1.1 Technology Readiness

The three primary goals of the NMD Technology Readiness Program are:

- Focus technology research to ensure the capability to deploy a limited NMD system in the next decade (technology development).

- Continue basic technology efforts to infuse new advances as the program proceeds (technology infusion).

- Conduct contingency planning and options development to meet an unexpected threat (contingency deployment planning).

The NMD Technology Readiness Program would continue to test and develop existing and new technologies without producing and deploying a complete system. It also would provide cost and performance benefits and reduce associated technical risk. The program could allow for the streamlining of the acquisition process, if required at a later date, for quick transition to full-scale development if and when required. An initial contingency capability would be available soon after the end of fiscal year (FY) 1998 and would be upgraded as the program matured. Thus, the program would provide a contingency capability against an unexpected threat and would minimize the time required to deploy a state-of-the-art limited NMD system.

The Technology Readiness Program consists of time frames, each nominally 3-4 years in duration, beginning in FY 1995. Critical, long-lead time technical capabilities would be demonstrated and evaluated, then further developed and refined during each successive time frame. The Technology Readiness Program would be designed to demonstrate an increasing technical capability and to assess the effectiveness of a possible rapid deployment of an NMD system (Bailey, 1994a).

The program would also involve continued research into existing technologies and further design and experimentation in new technology areas. Additional research would parallel element development and evaluation. Successful technology research increasing NMD element capabilities would be cycled into each consecutive term for demonstration and evaluation (technology infusion).

The multi-stage approach would provide a means to maintain technological parity with evolving threats. It would also provide for contingency NMD planning should a defense capability be required.

2.1.1.2 System Acquisition

The NMD Program was a system acquisition program before changing world events made the need for the system less urgent. Currently, the NMD Program is not a system acquisition program; however, world events could require that it become one in the future. Since this PEIS includes alternatives which involve acquisition and is intended to cover these through development and testing, the following decription of the DoD System Acquisition Process (DoD, 1991) is provided.

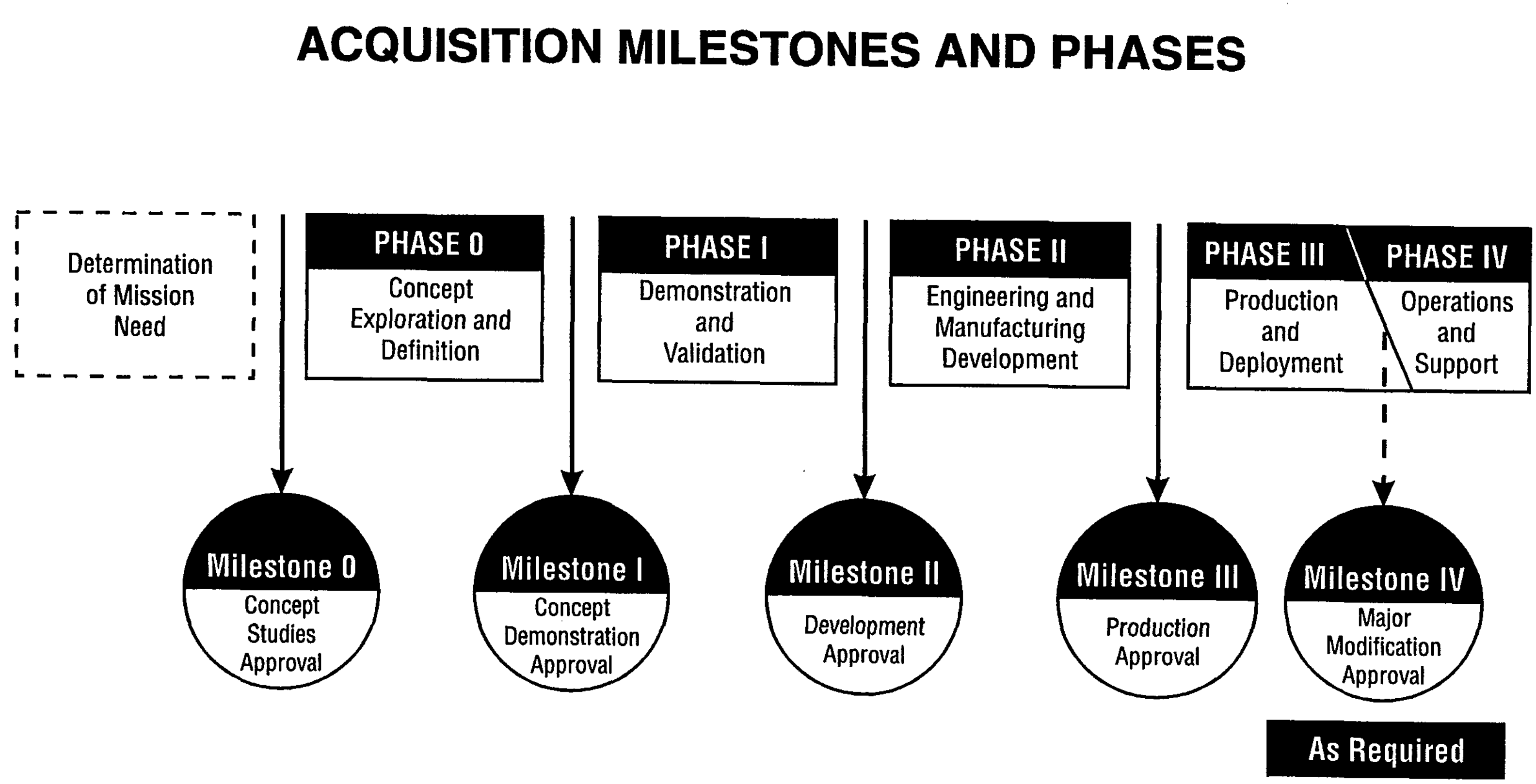
As major defense system acquistion programs are developed they progress through logical phases separated by major decision points called milestones (Figure 2-1). The five phases in the system acquisition process are concept exploration and definition, demonstration and validation (DEM/VAL), engineering and manufacturing development (EMD), production and deployment, and operations and support. A more detailed discussion of the system acquisition process is presented in Appendix E.

The first phase in the system acquisition process, concept exploration and definition, involves the study of alternative concepts for a defined mission. Concept exploration activities typically focus on paper studies to identify the most promising concepts and the associated technical risk areas. At the conclusion of the concept exploration and definition phase, a decision is made to set up a formal system acquisition program.

The second phase in the process, DEM/VAL, involves the definition of characteristics and capabilities and the demonstration of critical technologies. DEM/VAL activities emphasize tests that demonstrate the functioning of system elements and their components, and design characteristics and capabilities. The final objective of DEM/VAL is to provide the information necessary to support a decision to go into EMD.

EMD, the third phase, involves developing the final system design prior to production. A key objective is to ensure that system capabilities meet specification requirements and satisfy need and performance requirements. This phase also includes refining the system design and validating the manufacturing process. Test and evaluation activities involve prototype system elements. Tests are conducted to verify that all aspects of the design meet technical and operational requirements. Evaluation activities include tests at the element component level, element subsystem level, full element level, and system level.

The objectives of the production and deployment phase, which follows EMD, are to establish a production and support base; achieve an operational capability that satisfies mission needs; and conduct follow-on testing to confirm and monitor performance and quality, and verify the correction of deficiencies. Production activities, typically carried out at contractor



Source: DoD, 1991.

Figure 2-1. System Acquisition Life-Cycle

facilities, involve component fabrication and manufacture; component assembly; testing of components and integrated systems; and shipping. Deployment includes basing actions necessary to meet system operational capability.

The final phase, operations and support, involves the activities necessary to maintain the system operations required to meet the mission needs. Any system deficiencies identified during this phase may be corrected by system modifications or upgrades.

Decommissioning is not a formal phase in the system acquisition process but is a normal conclusion to the system life-cycle. Decommissioning occurs when the system has exceeded its design life and can no longer perform its mission, or when the system is no longer required due to a change in mission. Decommissioning could involve complete termination of operations and disposal of the system or its replacement with a new or upgraded system.

Potential production and deployment and later life-cycle activities and impacts are identified for the System Acquisition Alternatives to inform the decision maker of future consequences of the Alternatives included herein. If BMDO decided to proceed with one of the System Acquisition Alternatives, this PEIS would support the decision through EMD. Further environmental documentation would be required to support a decision to proceed to later life-cycle phases. Even though they are contained within the same acquisition phase, production and deployment are discussed separately in this PEIS to identify potential environmental impacts from each activity. Also, for the purposes of this PEIS, operations and support are discussed with deployment, as they are more closely related for the purpose of environmental analysis.

2.1.2 DESCRIPTION OF ELEMENTS

The following section contains brief descriptions of the elements that have been considered for development in the NMD Program. These include sensors (instruments that detect energy emitted or reflected from objects), interceptors, and the system management element. Sensors can be either Ground-Based Sensors (GBS) or Space-Based Sensors (SBS). The currently planned NMD Technology Readiness Program would initially emphasize Ground-Based Interceptor (GBI) technologies. Space-Based Interceptor (SBI) activities are not part of the Preferred Action. For a more detailed discussion of the elements considered for development, see Appendix F.

GBS, specifically ground-based radar (GBR), would perform incoming missile detection, identification/ discrimination, and tracking functions. GBR would be an active, phased array radar system able to detect and track endo- and exoatmospheric objects (objects within and outside the earth's atmosphere)

by transmitting electromagnetic radiation and detecting reflections off the object. GBR could also provide information on objects to support pre-launch and in-flight interceptor operations. Two other examples of GBS include ground-launched sensors (GLS) and upgraded early warning radars (EWR). GLS, a concept which has been considered in the past but is not being carried forward, would be a fixed, rocket-launched, suborbital surveillance system. The EWR system is a network of existing radars which confirm launches, track missiles, predict launch and impact points, and assess threats of missiles launched at the continental United States (CONUS). EWR systems are located in Alaska, California, Georgia, Maine, Texas, Greenland, and England.

Upgrades to the EWR system would consist primarily of software and minor hardware changes. The upgraded EWR would support other ground-based assets by providing improved data on missile tracks and object identification and discrimination.

The GBI element would be a fixed-based interceptor designed to destroy its target by force of impact. The GBI element would include the interceptor and associated launch and support equipment, silos, facilities, and personnel. The interceptor missile includes two main components: the boost vehicle and kill vehicle (KV) payload. Once an interceptor is launched to destroy an incoming missile, it can receive updates on the missile's flight from external and/or internal sensors. The GBI is capable of controlling its flight path in order to home in on and intercept an incoming missile. It is capable of intercepting and destroying a missile outside the earth's atmosphere, thus greatly reducing the effects on the ground.

The SBS element would be an earth-orbiting satellite system designed to detect, identify, discriminate, and track incoming missiles. The SBS would be placed in orbit using existing space launch vehicles and facilities. The SBS is a passive sensing system that may be cued to search a specified area. Communications between SBS and the other elements would be by Battle Management/Command, Control, and Communications (BM/C3) rather than directly with element units.

The SBI element (development and testing of which is not part of the Preferred Action) would be an earth-orbiting satellite system combining surveillance and intercept functions on a single spacecraft. The SBI would also be placed in orbit using existing space launch vehicles and facilities. Like SBS, an SBI would be able to detect, identify, discriminate, and track ballistic missile targets. Upon cue from the system operator, a dormant SBI could be activated to release interceptors at a target (ballistic missiles, reentry vehicles, or anti-satellite missiles). The interceptor would destroy a missile by direct impact at high speed. An SBI would be able to intercept a missile earlier in its trajectory than a GBI.

The BM/C3 would provide the infrastructure unique to the NMD system that would allow planning, coordination, command, and control of BMD system operations. The BM/C3 network could consist of a number of connected command and operations centers and weapon and/or sensor sites. Information would be gathered by sensors and relayed to command and operations centers. At these centers the battle management and command functions would occur (including threat validation and authentication, course of action, delegation, and weapon release authorization). The BM/C3 network would then route information to interceptors and in-flight units. BM/C3 could include both terrestrial and satellite communications networks. Space-to-ground earth stations would connect these networks. Ground Entry Point (GEP) assets would provide the up/down link interface to in-flight GBIs. GEPs are similar in both physical and design features to communication devices used for television and radio signal transmission and reception.

2.1.3 SUMMARY OF ALTERNATIVES

Alternatives were considered based on cost and operational effectiveness of available technologies. The Preferred Action is to continue a Technology Readiness Program that would enable the United States to produce and deploy a state-of-the-art NMD capability at some point in the future, should it become necessary. Possible architectures for an NMD system are described in the System Acquisition Alternatives, which are presented in the general context of the DoD system acquisition lifecycle. The Preferred Action is not described in terms of system acquisition lifecycles. Instead of being an acquisition program, it involves technology research and development, and testing and evaluation of element prototypes and software.

2.2 PREFERRED ACTION

This document evaluates the activities of the Preferred Action and several System Acquisition Alternatives. The Preferred Action is the continuation of an NMD Technology Readiness Program as described in the PEIS. Activities under the Preferred Action are ongoing programs initiated under existing Congressional and legislative direction. In this case, the Technology Readiness Program is "no change" from current management direction or level of management intensity. Since there is no substantial change in direction or commitment of resources, this action will be considered to be the equivalent of the traditional No Action Alternative called for by the Council on Environmental Quality (CEQ) regulations for implementing the provisions of the National Environmental Policy Act (NEPA). The objective of the NMD Technology Readiness Program is to develop long-lead technologies. This would provide improvements to current technologies and enhance concepts for NMD contingency deployment.

2.2.1 OVERVIEW

The Preferred Action would be to implement an NMD Technology Readiness Program consisting of three terms, each nominally 3-4 years in duration. The Technology Readiness Program would be driven by the accomplishments of research and development activities and not by the duration of each term. Critical long-lead technologies within NMD element programs would be researched and developed. Upon demonstration and evaluation of critical technologies, a determination would then be made as to whether the element system or subsystem would be ready to proceed into the next term for continued research and development. In addition, separate technology infusion activities would be pursued in parallel with the research and development program. Residual technology infusion research providing extra capabilities to NMD elements would be rolled over into the next term of development.

Each successive term would provide a means of maintaining contingency defense parity with any evolving threat, and would provide the United States with the capability to produce and deploy a state-of-the-art NMD system, if required. The goal of the Technology Readiness Program is to continue development of complex subsystems which could be coupled with existing technologies if a need arises for NMD system capability. Acquisition of an NMD system is not part of the Preferred Action.

2.2.2 DESCRIPTION OF ELEMENT ACTIVITIES

This section provides descriptions of the proposed activities for each element under the Preferred Action. Elements in the NMD Technology Readiness Program include GBI, BM/C3, GBS, and SBS. In each case, activities would be conducted in accordance with existing safety requirements and all applicable laws and regulations. Whenever possible, NMD Technology Readiness Program activities would be performed in existing research, development, and testing facilities. A limited amount of new facility construction or modification is anticipated.

2.2.2.1 Ground-Based Interceptor

The first term of GBI technology development, the early-term, would focus on demonstrating and evaluating interceptor technologies for a ground-launched exoatmospheric kill vehicle (KV). The program would focus on the design and development of an exoatmospheric KV through ground testing, followed by a flight-test program. In conjunction with exoatmospheric KV development, an experimental seeker (a short-range internal sensor instrument) would be developed and flown in a test mode. Activities in the early-term would include small-scale research, manufacturing, and testing of components at contractor and government facilities. Flight tests would be conducted at government test ranges, using existing booster systems and launch facilities.

Early-term technology infusion research for GBI would concentrate on development of computer processes for target discrimination, and seeker cryocooler (very low temperature cooling units) technology. Activities would include small-scale computer simulations, manufacturing, and testing of components at contractor and government facilities.

The second term of GBI technology development, the mid-term, would focus on demonstrating an enhanced exoatmospheric KV by means of a series of flight tests. The flight tests would demonstrate interfaces and interoperability with radar through a selected set of prototypical BM/C3 technologies. Additionally, development of an extended-range long-wavelength infrared (LWIR) seeker with a focal plane array (a matrix of light-sensitive detectors which provide image data for emitted light frequencies), optics, cooling, and signal processing would be pursued to increase interceptor sensing distances and thereby increase intercept capabilities. Activities would include small-scale research, manufacturing, and testing of components at contractor and government facilities. Similarly, flight tests would be conducted at government test ranges.

The third term, the objective system, would focus on combining the principal elements of an NMD system and testing their combined capability to perform a ground-based intercept with SBS cueing and active radar launch control (system testing). This would include a GBI with integrated boosters and advanced exoatmospheric KV. This GBI would be capable of being integrated into an NMD system that could defend against a (non-massive) ballistic missile attack. Activities included in the objective system would be small-scale research, manufacturing, and testing of components at contractor and government facilities. Again, flight tests would be conducted at government test ranges. No activities beyond the objective system have been identified.

2.2.2.2 Battle Management/Command, Control, and Communications Element

Early-term effort in BM/C3 would focus on the modification and use of off-the-shelf hardware and software products to demonstrate integration and data transfer capability. BM/C3 would provide for development of a weapons tasking plan that would provide for situation assessment, human weapon control, and situation evaluation. Communications tasking plans for war fighting operations of the GEPs would be developed and demonstrated. In addition, command and communications system capability would be demonstrated using prototypical hardware and software. Activities in the early-term would include small-scale research, computer simulations, manufacturing, and testing of components at contractor and government facilities.

Early-term technology infusion research for BM/C3 would focus on software and algorithm development on commercial and government off-the-shelf computer equipment. Activities would include small-scale research, computer simulations, manufacturing, and testing of components at contractor and government facilities.

The mid-term and the BM/C3 objective system would focus on further integration of the principal elements of an NMD system. Testing of the combined capabilities of NMD elements to perform a ground-based intercept with SBS cueing and active radar launch control (system testing) would be performed. Sensor data combination and weapon-to-target pairing would be integrated into the core capability of BM/C3 functions developed in the early- and mid-term to demonstrate a fully capable BM/C3. BM/C3 would be capable of integrating into an NMD system that could provide defense against a limited ballistic missile attack. Activities included in the mid-term and objective system would be small-scale research, computer simulations, prototyping manufacturing, and testing of components at contractor and government facilities.

2.2.2.3 Ground-Based Sensor

During the early-term, active GBS technology development would focus on sensor object discrimination, target damage assessment, target object maps, mechanical and electrical algorithm development, real-time digital simulation, and hardware-in-the-loop testing. Activities included in this generation would be small-scale research, computer simulations, manufacturing, and testing of radar components at contractor and government facilities.

Technology infusion research for GBS would focus on advanced solid state transmit and receive modules and advanced discrimination algorithms. Activities include small-scale research, computer simulations, manufacturing, and testing of components at contractor and government facilities.

During the mid-term, radar technology development, real-time digital simulation, and hardware-in-the-loop testing would continue. A radar technology demonstration effort would also be conducted. This effort would modify the TMD-GBR radar into a NMD performance-class radar by expanding its aperture, increasing its power, and modifying its electronics. Radar tracking of flight tests would be conducted at government test ranges. Other activities would include small-scale research, manufacturing, and testing of components at contractor and government facilities. Radar tracking of flight tests would be conducted at government test ranges.

The objective system would focus on combining the principal elements of a NMD system. The capabilities of the combined NMD elements to perform a ground-based intercept with SBS cueing and active radar launch control

(system testing) would be tested. GBS would be capable of being integrated into an NMD system that could provide defense against a limited ballistic missile attack. Activities would include small-scale research, manufacturing, and testing of radar components at contractor and government facilities. System integrated flight tests would be conducted at government test ranges. No activities beyond the third generation have been identified.

2.2.2.4 Space-Based Sensor

In the early term of technology development, passive sensor technology involving cryocoolers and focal plane arrays would be developed and demonstrated. Activities would include small-scale research, manufacturing, and testing of components at contractor and government facilities.

Early-term technology infusion research would concentrate on developing focal plane arrays processors, communication components, and cryocooler technology and conducting space target-tracking experiments. Activities would include small-scale research, manufacturing, and testing of components at contractor and government facilities.

The mid-term time frame would continue development and ground testing of cryocoolers and LWIR focal plane arrays. Flight demonstration satellites would be used to test SBS functions and operations, collect critical background and target information, and verify flight testing technology. Activities would include small-scale research, manufacturing, and testing of components at contractor and government facilities. Any required flight tests or launches would be conducted at government facilities.

The objective system would focus on combining the principal elements of an NMD system. The capabilities of the combined NMD elements to perform a ground-based intercept with SBS cueing and active radar launch control (system testing) would be tested. The LWIR and advanced LWIR sensors would be ground tested to provide confidence in design and performance prior to a deployment decision. A fully mission-capable SBS would be integrated into an NMD system that would be demonstrated to be capable of providing defense against a limited ballistic missile attack. Activities would include small-scale research, manufacturing, and testing of components at contractor and government facilities. Any required flight tests or launches would be conducted at government facilities. No activities beyond the objective system have been identified.

2.2.2.5 Supporting Research

Additional research not discussed above may be conducted in support of the NMD Program. For the most part these activities would include small-scale

research, manufacturing, and testing of components at contractor and government facilities.

2.2.2.6 Contingency Deployment Planning

The Technology Readiness Program is not an acquisition program, although contingency planning for a limited NMD system is included in it. Many of the program activities comply with the spirit of acquisition streamlining and reform to achieve the best value. The goals of acquisition streamlining are to increase the efficiency and effectiveness of the acquisition process and to reduce the time required for acquisition without committing the necessary resources. If a threat warrants a response, the Technology Readiness Program could quickly become an acquisition program during any term. Contingency deployment planning would be consistent with the ABM Treaty and would be developed to provide a highly effective defense of the United States against limited missile attacks.

Contingency deployment planning would be an integral part of the NMD program. The planning would assess the limited NMD capability that could be provided at any point in the program and outlines the activities required to efficiently acquire and deploy a limited NMD system. The Technology Readiness Program would focus on critical technologies and capabilities to minimize the time required to deploy an initial system, if necessary, and at the same time it would continuously weigh contingency options as insurance against missile threats.

2.3 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

The Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors (GB/SB) System Acquisition Alternative would involve proceeding with a GB/SB system through the EMD phase of the system acquisition process. This system would provide a layered defense by incorporating GBS, SBS, GBI, and SBI elements with BM/C3 (Figure 2-2). This section is divided into two subsections. The first, Development and Testing (D&T), describes EMD element activities. The second, Other Life-Cycle Activities, describes anticipated actions should future decisions be made to continue with the acquisition of this alternative; this subsection is provided for information only.

2.3.1 DEVELOPMENT AND TESTING

An NMD test program for the GB/SB Alternative would concentrate on the functional interactions between system elements. The test program would assess the ability of an NMD system to collect, store, and transfer data accurately, effectively, and efficiently. The system must be capable of

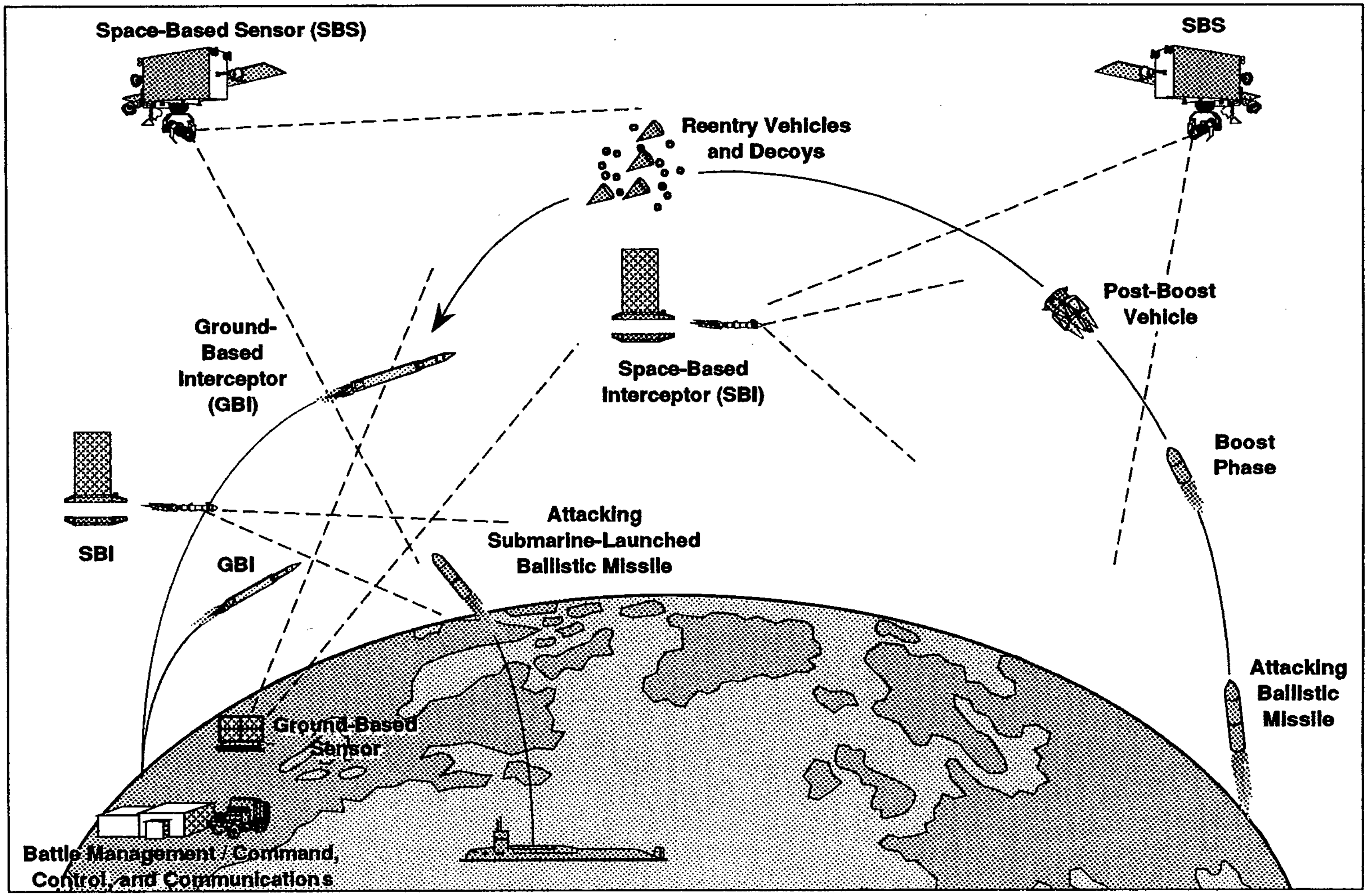


Figure 2-2. A Ground- and Spaced-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative

transferring threat data, element status, and command traffic in natural and hostile environments.

D&T would require government and contractor research facilities, test ranges, and manufacturing facilities normally used to test and produce such systems. Testing would begin at the component level and progressively evolve through element subsystem and element testing to NMD system-level integrated testing. Successive tests would build upon the data accumulated from each previous level of testing. Testing would focus on the integrated use of computer simulations, prototypes, emulations, and flight and ground tests.

Element testing would be based upon identified requirements. Extensive simulation tests of actual component and subsystem hardware would be performed in laboratory test facilities. Critical interfaces would be validated by tests integrating two or more elements. These would lead to full-scale prototype testing and to the testing of sets of elements.

Interceptor flight tests could be conducted at the U.S. Army Kwajalein Atoll (USAKA) with support from facilities at Wake Island, Kauai Test Facility in Hawaii, Vandenberg Air Force Base (AFB) in California, and other sites. GBS, SBS, and BM/C3 could be tested at USAKA and/or the National Test Facility at Falcon AFB in Colorado. Target missiles would be required to provide realistic threat objects for interceptor and sensor testing. Target missile launch operations would occur at government launch sites. Some new facilities or modifications to existing facilities might be necessary (e.g., command facilities including operations centers, GEPs, support equipment buildings, and other infrastructure). These facility activities would be subject to site-specific environmental impact analysis as required.

A number of test ranges exist for NMD system live test scenarios. Equipment at a system test site would include primary, ancillary, support, and BM/C3 equipment for GBSs and GBIs. The USAKA facility would potentially be used for NMD testing throughout the NMD lifecycle. Other test locations may include but are not limited to the Pacific Missile Range, Hawaii; Eastern Test Range, Florida; Western Test Range, California; China Lake Naval Weapons Center, California; White Sands Missile Range, New Mexico; and National Aeronautics and Space Administration flight test centers (Wallops Island, Virginia and Poker Flat, Alaska).

2.3.1.1 GBS Development and Testing

GBS activities would include design, fabrication, assembly, and testing of components and assemblies, and functional testing of systems against actual target missiles. Design, fabrication, and assembly would occur primarily at existing contractor facilities. Testing of components and assemblies could take place at both contractor and existing government test

facilities. Functional testing would occur at existing government test ranges. These activities would include environmental and operational tests under simulated field conditions, and computer simulations.

Currently, the GB/SB System Acquisition Alternative would involve the construction of a prototype GBR, and potential research and development of other GBS technologies. Functional testing of the GBR would demonstrate its ability to acquire, track, and discriminate between objects in flight. These tests would use targets of opportunity (i.e., launches supporting other programs) and target missile launches specifically scheduled for GBR testing. All radar development and testing activities would comply with applicable federal and state regulations for worker and public exposure to electromagnetic radiation. Other GBS technologies include ground-launched sensors and upgraded EWRs.

2.3.1.2 GBI Development and Testing

Element and technology testing for GBI would focus on performance of the boost vehicle and the various components of the KV, as well as overall element performance. D&T of the interceptor missile include designing, fabricating, and testing the missile components both individually and as an integrated unit. These activities would occur at both contractor and government facilities.

GBI seekers and sensors would be tested on the ground by checking electrical connections, functionality, and performance. Ground testing of the seeker and sensor subassemblies generally would occur in enclosed facilities and require the simulation of target missile signatures and operational environments. Some tests could involve connecting actual seeker or sensor units to a computer system that would simulate other interceptor components to demonstrate subelement and element functional performance. Ground tests of seekers and sensors and integrated interceptors could also involve the use of a sled at an existing test track facility. Sled tests would measure component durability. The carriage sled would typically be propelled by surplus rocket motors. Ground tests of seekers could be performed in altitude and space simulation chambers (including vacuum, radio frequency generation, solar radiation, and radiation cooling chambers). Radiation and environmental chamber tests are conducted at contractor facilities.

The KV would be fabricated and tested at contractor facilities. The KV propulsion and attitude control systems can be tested on the ground by pressure testing and static firing of the motors. Propulsion tests may involve hover-testing to determine the ability of the propulsion system to respond to directions from the avionics subsystem.

Fabrication and/or modification of rocket motors would likely be performed at contractor facilities. The manufacture of rocket motors primarily involves developing and testing propellant formulations, casing materials, and sub-scale rocket motors at contractor and government facilities. Static firing tests would be conducted at approved facilities.

Tests conducted on the missile airframe could include wind tunnel and static load tests. Such tests would be conducted at contractor facilities with current permits for similar testing activities.

The following tests could be conducted on the integrated missile: environmental tests (e.g., thermal and mechanical shock and temperature-altitude), electromagnetic compatibility/interference tests, ground tests, and flight tests.

Flight testing would be performed to verify performance and to test the interceptor's ability to engage and destroy target missiles under realistic conditions. Certain tests would involve only the acquisition of the target missile by the interceptor's seeker/sensor, while in other tests the target missile would actually be destroyed. In all cases, safety analyses would be conducted to ensure that any debris would fall in predetermined areas in order not to endanger human health and safety and to avoid or minimize harm to environmentally sensitive resources. Typically, several flight tests are conducted within a given test program (SDIO, 1992).

Flight tests may occur at government flight test ranges within and outside the United States. Flight test parameters vary greatly with regard to trajectory and range. All flight testing of ground-launched interceptors would be suborbital. Depending on the flight profile and the location, spent payloads and debris from experimental target missile intercepts would fall in the ocean or on land within a delineated debris impact area. Debris falling on land would be recovered whenever possible except in areas of extreme environmental sensitivity. Natural resources agencies could be consulted for input into recovery activities. Safety is a primary consideration in flight-test planning.

It is anticipated that fabrication of test articles or on-the-ground testing of components would involve construction of new facilities. Some modifications to existing test facilities would be anticipated to create an operationally representative launch facility. Launch areas might have to be modified to support the various interceptor/booster configurations.

2.3.1.3 SBS Development and Testing

The SBS would require extensive testing in support of development. Ground-based tests would analyze technology and functionality of components. Tests would be modular and would integrate hardware upgrades in response to evolving designs and improvements.

SBS tests would involve operational testing of the sensors. The integrated sensors would be optimized through ground-based demonstrations before any flight testing. The SBS would require a very low temperature control system to cool detectors and optics to desired levels of sensitivity. The device would be constructed and tested to demonstrate that final temperatures could be achieved and maintained over an operational cycle.

SBS flight tests would demonstrate sensor performance using realistic space targets and backgrounds. These tests would utilize orbiting prototype spacecraft without a full complement of sensors and demonstrate real-time, line-of-sight target identification and tracking. Ground testing of LWIR and advanced LWIR sensors in addition to the flight demonstration satellites would provide the necessary data for a deployment decision.

SBS test spacecraft would be placed in orbit with existing space launch vehicles. Launches would occur at existing government launch complexes and utilize existing facilities. Should new facilities or major modifications to existing facilities be required, appropriate environmental documentation would be prepared.

2.3.1.4 SBI Development and Testing

SBI element testing would involve ground tests and preflight and flight tests to determine if element designs satisfy mission performance requirements. Ground tests would be used as a cost-effective means of verifying performance. The tests would focus on the KV and sensor and on integration of these components. Vacuum chambers would be used in the evaluation of the SBI spatial orientation control hardware. These tests would demonstrate the SBI's ability to orient itself and to detect, acquire, and track a target. Ground tests of SBI element integration would also involve computer simulation tests, including actual element hardware. SBI orbital flight tests would be designed to provide data to resolve critical technical and operational issues. These tests would demonstrate SBI capability to perform autonomous detection, tracking, correlation and communications. SBI spacecraft would be placed in orbit by existing launch vehicles. Existing missiles and aircraft could be used as targets for detection and tracking. As currently envisioned, the test program would not include orbital intercept tests. Launches would occur from an existing government launch complex.

2.3.1.5 BM/C3 Development and Testing

The National Test Facility at Falcon AFB, Colorado Springs, Colorado, is a potential focal point for development and testing of BM/C3. BM/C3 development would include the analysis and evaluation of management and command scenarios, most likely by computer simulation. Testing would validate BM/C3 software to ensure achievement of requirements. BM/C3 testing would begin with simulations and emulations and progress to integrated element and prototype tests. BM/C3 capabilities would also be incorporated into interelement tests (e.g., system tests).

2.3.1.6 System-Level Integrated Testing

System-level integrated testing would involve two or more elements to ensure that element performance and interfaces would support the NMD system. Testing and evaluation would consist of computer simulations, ground tests, and launches at government and contractor facilities. Prototype facilities (e.g., an operations center would be constructed), components (e.g., GEPs) and subsystems, and techniques would be manufactured, constructed, and used (SDIO, 1992).

In early system integrated testing, the test structure would be developed, while system performance would be extensively modeled using computer simulations. The models used in the integrated system testing would duplicate the real-time capabilities of the system in order to evaluate the data and command handling functions of the elements. As development proceeded and data on prototype hardware became available, increased emphasis would be placed on the use of actual hardware performance test results for maximum realism. Following that, many of the final development tests and early operational tests would make extensive use of hardware exercises in which all or some of the prototype elements are connected.

A system test site would either be constructed or modified from existing facilities to support testing. Tests would progress from simple target/interceptor engagements to more complex sets of targets, sensors, interceptors, and BM/C3 functions. Following the end of system testing, a thorough evaluation of results would be conducted to verify overall system effectiveness. Only through this type of testing, evaluation, and refinement could the NMD system be proven to meet its performance requirements.

Operational Testing and Evaluation would provide a basis for practical training of operational personnel. Testing would demonstrate NMD element operational effectiveness and suitability under combat conditions. Activities would involve system exercises and launches at test sites.

2.3.2 OTHER LIFE-CYCLE ACTIVITIES

This section describes the life-cycle activities beyond D&T, if the GB/SB System Acquisition Alternative were chosen. These activities are not part of this alternative and are provided only for environmental planning and information. The other life-cycle activities include production, basing, system operations and maintenance, and decommissioning. This discussion represents the best available information. A decision to ultimately advance to these phases of the acquisition process would require additional environmental impact analysis tiered from this PEIS.

2.3.2.1 Production

Components and systems are fabricated and assembled during the Production life-cycle phase. All production activities would be in accordance with standard industry practices. Standard manufacturing procedures would be followed whenever possible. Deviations from normal procedures would be identified and addressed on a case-by-case basis.

An NMD system would require boosters to support the program. GBI might require the design, development, and production of a new booster. Existing or refurbished boosters would be used for test targets and for deploying space-based systems (i.e., SBS, SBI).

The processes and materials involved in developing passive sensors and seekers are generally the same. The substantial difference is in the scale; surveillance sensors are much larger than interceptor seekers and require greater processing capabilities. SBSs use passive sensors which detect energy emitted from sources; GBIs and SBIs use passive or active seekers. Active seekers emit energy and detect that energy reflected off a target. Sensor and seeker components are made of a variety of materials, including durable and optically desirable materials and metallic compounds. Thermal-control subsystems are required to cool detectors and optics to desired levels of sensitivity.

Electronic components are found in every element. They include electronic components for data and image processing on sensors and seekers, solid-state modules and components in radars and ground entry points, data processors in the BM/C3, and avionics systems on interceptors. Fabrication, assembly, and component integration would take place in contractor facilities equipped for electronic component production.

Power sources are needed for GBIs and space-based elements. GBI would utilize a battery power source to power internal systems. However, conventional batteries are not an effective power source for sustained space operation because of their size and weight; solar panels or solar concentrators are more likely candidates for space-based elements.

Fabrication of power sources would take place in contractor facilities equipped for such production.

2.3.2.2 Siting, Basing, and Operations and Maintenance Support

Siting

An NMD siting process would recommend deployment locations that optimize system performance and minimize cost, schedule, and environmental impacts. The NMD site selection process would consist of four steps: System Requirements Documentation, Basing Concept Analysis, Area Narrowing, and Location Evaluation. System Requirements Documentation would be reviewed along with the system architecture to derive exclusionary and evaluative criteria. Exclusionary criteria are requirements or constraints for effective system operation. Evaluative criteria are conditions desired to enhance system effectiveness or minimize adverse effects. Basing Concept Analysis would be used to define the number of bases required to achieve an adequate threat response capability, their approximate locations, and the minimum requirements a location must meet to be considered as a site. Area Narrowing analysis would screen potential sites within the approximate locations and identify a number of specific locations that meet the requirements for deploying elements of the system. The product of the Area Narrowing step would be an unranked listing of candidate sites. Location Evaluation would measure the relative suitability of each candidate site against a list of preferred characteristics. Once locations were selected, they would be investigated more extensively. This step would result in the final siting of elements and the beginning of master planning.

Site preparation and facility construction would be initiated after site selection. As operational facilities, system installation, and assembly and checkout testing were completed, the initial site could be made available to fulfill an early operational need. Under this Alternative, the initial site would consist of the local components of the BM/C3 plus the initial deployment of GBI and GBS. Additional deployments would be as required to meet national objectives as allowed by existing treaty obligations.

Basing

The basing concept of the GB/SB Alternative would involve a number of required facilities. These sites include a hierarchy of BM/C3 and operations centers, GBS/GBI sites, common support facilities, and a network of GEPs to provide communications links with space-based assets and between ground-based elements.

Where possible, the BM/C3 centers would be located in existing facilities to take advantage of existing infrastructure. These facilities typically require

fewer than 200 personnel. There are few constraints to locating these centers. It is likely that these operations would be collocated with other command centers. Many of these locations are flexible, since satellite communication terminals can transmit and receive data to and from any location.

As much as possible, GBI and GBS would be based on existing federally owned installations to take advantage of the support infrastructure. Common facilities required at the site would include mission and personnel support, infrastructure, and training facilities. GBIs must be sited and based so that they can intercept and destroy their targets. GBS facilities may be collocated with GBI facilities. Basing requirements of ground-based sites would vary with operations. It is possible that land in addition to that available on existing installations would be needed to meet area requirements (e.g., standoffs between GBI and GBS). A typical GBI site would consist of a Readiness Station, several GBI silo locations, and GEPs for BM/C3.

SBS and SBI would be placed in orbit with existing launch vehicles. Launch operations would take place at existing government launch complexes. Candidate complexes would be judged against a list of preferred characteristics. A complex would then be selected to meet launch requirements.

Operations and Maintenance Support

Should the segments be developed, tested, manufactured, and deployed to a ground location or in space, the elements in them would be monitored and maintained in a continuous state of readiness. Operations and maintenance support would include all material and supporting services necessary to field, operate, secure, maintain, and support the elements. In all operations and maintenance activities, the Services would ensure that proper safety and environmental protection measures were planned and instituted in accordance with DoD, Service, and other applicable guidelines. Ground operations facilities would be required to maintain both ground-based and space-based elements.

2.3.2.3 Decommissioning

Decommissioning would occur when the system, an element, or a particular facility could no longer perform its mission or was no longer required. Decommissioning could involve complete termination of operations and disposal of the system or components, or upgrading the system or components.

Decommissioning activities could take place at contractor and government facilities. Facilities, computer hardware and software, fiber-optic cable, and

related equipment would be dismantled, sold, or reused for other activities. Disposal would conform to all federal and state laws for minimizing waste products and air emissions. All salvageable items would be handled as reusable materials or scrap. If possible, materials would be recovered and reused; otherwise, they would be disposed of in accordance with applicable laws, regulations, and permits.

Space-based elements would be abandoned in orbit, parked in a higher orbit, or deorbited to burn up upon reentry into the atmosphere. SBS could be made available to support other surveillance missions.

2.4 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

The All Ground-Based System Acquisition Alternative would have all of its interceptors and sensors located on the earth's surface or in underground silos. This Alternative consists of GBIs, GBSs, and a BM/C3 that links the elements (Figure 2-3). The concept of GLSs, depicted in Figure 2-3, has been considered but is not currently being carried forward. Though the elements of this alternative are all on the ground, they can be coupled advantageously with other national defense elements such as the EWR system or with assets like the Defense Support Program or Follow-on Early Warning System satellites based in space.

This alternative would require more ground-based sites for system effectiveness than the GB/SB Alternative. Without the surveillance coverage of SBS, more GBSs located around the perimeter of the CONUS, Alaska, and Hawaii would be required. Similarly, this alternative would require more GBIs than in the GB/SB Alternative. Without the advantage of the first line of defense provided by SBIs, more GBIs located at additional sites around the country would be required to maintain system effectiveness.

2.4.1 DEVELOPMENT AND TESTING

D&T activities for this alternative would be similar to those described for the ground-based elements and BM/C3 of the GB/SB Alternative. However, there would be no BM/C3 development and testing activities related to space-based elements.

2.4.2 OTHER LIFE-CYCLE ACTIVITIES

These activities are not part of this alternative and are provided only for environmental planning and information. The other life-cycle activities include production, basing, system operations and maintenance, and decommissioning. A decision to ultimately advance to these phases of the acquisition process would require additional environmental impact analysis tiered from this PEIS.

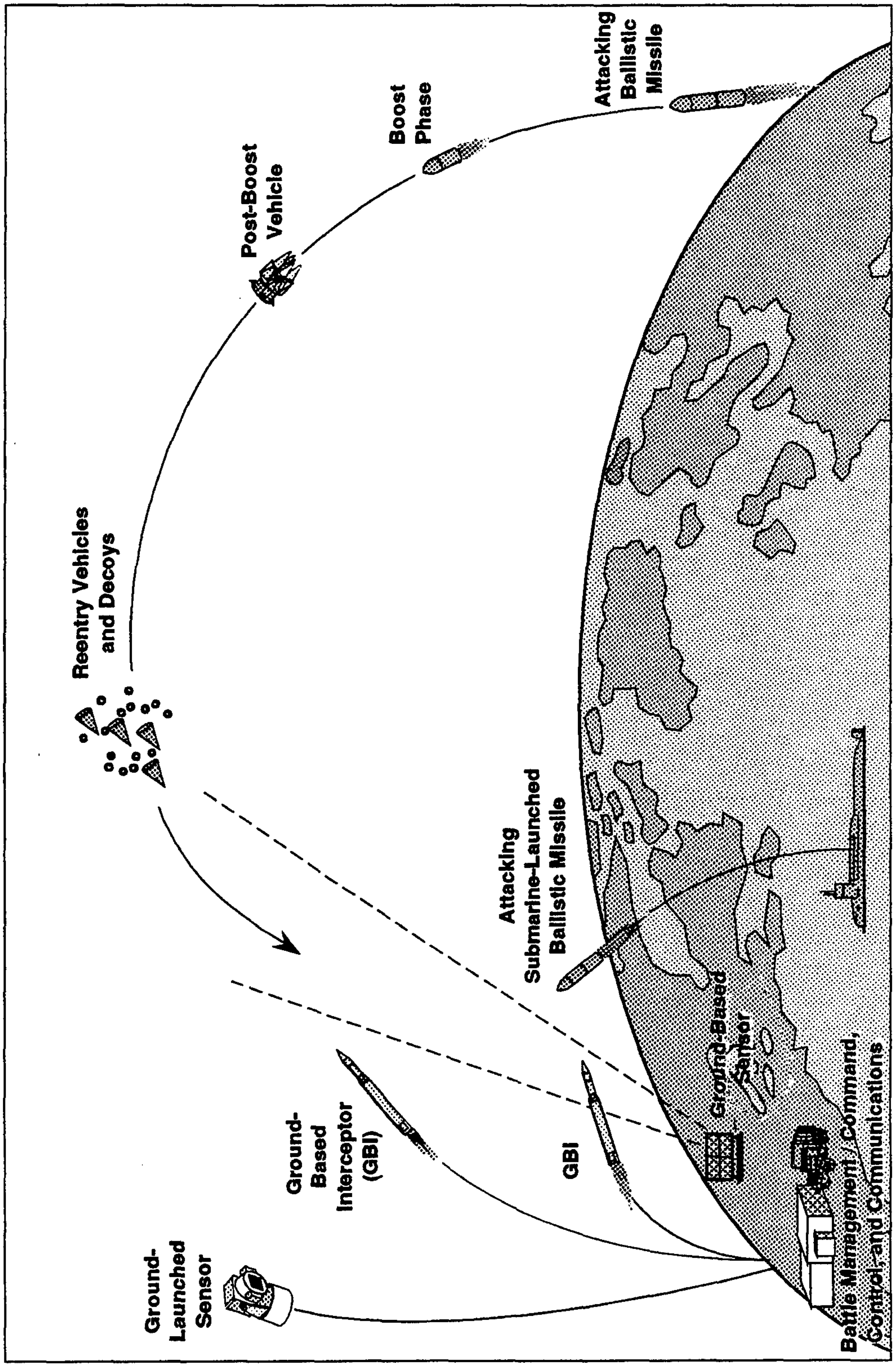


Figure 2-3. An All Ground-Based System Acquisition Alternative

Except for the requirements for a greater number of GBS/GBI sites and for an increased number of GBIs at these sites, the life-cycle activities for this alternative would be the same as for the ground-based elements and BM/C3 of the GB/SB Alternative. However, there would be no activities for space-based BM/C3 functions.

2.5 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

This alternative would consist of SBSs (currently Brilliant Eyes) with GBIs and GBSs, and a BM/C3 (Figure 2-4). This alternative has no SBIs. Highly effective ground-based protection requires early interceptor release. SBSs included in this alternative would provide early detection, tracking, and identification of threats. They would support earlier and efficient commitment of the GBIs.

The lack of SBIs in this architecture would preclude interception of a long-range missile during early flight phases, before the release of reentry vehicles and decoys. Therefore, this alternative would require more GBIs than in the GB/SB Alternative. Without the advantage of the first line of defense provided by SBIs, more GBIs located at additional sites around the country would be required to maintain system effectiveness.

2.5.1 DEVELOPMENT AND TESTING

D&T activities for this alternative would be similar to those described for the GBS, GBI, SBS, and BM/C3 of the GB/SB Alternative. However, there would be no BM/C3 development and testing activities related to the SBI element.

2.5.2 OTHER LIFE-CYCLE ACTIVITIES

These activities are not part of this alternative and are provided only for environmental planning and information. The other life-cycle activities include production, basing, system operations and maintenance, and decommissioning. A decision to ultimately advance to these phases of the acquisition process would require additional environmental impact analysis tiered from this PEIS.

The life-cycle activities of the GBS and GBI for this alternative would be nearly the same as for those elements of the GB/SB Alternative. There would be a need to produce and deploy more GBIs in order to maintain system effectiveness. The location of GBI sites would be affected by the lack of the SBI defense layer; however, this would be somewhat mitigated by the availability of SBS. The life-cycle activities of the space-based sensor would be similar to those in the GB/SB Alternative. The life-cycle activities of BM/C3 would also be similar to those in the GB/SB Alternative,

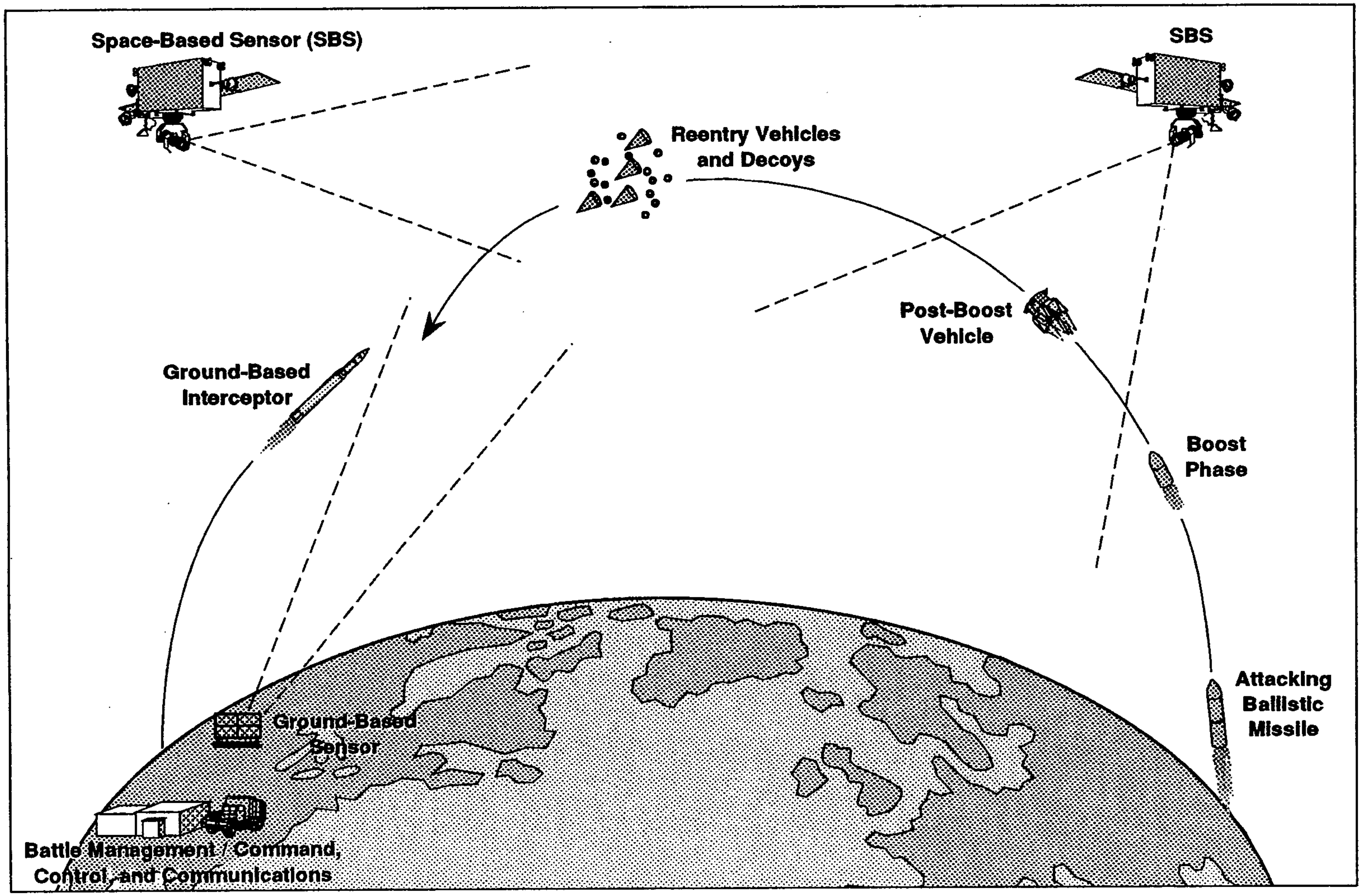


Figure 2-4. A Ground- and Space-Based Sensors and Ground-Based Interceptor System Acquisition Alternative

except there would be no SBI command and control functions. There would be fewer command center personnel, since there would be no SBI to monitor and maintain.

2.6 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD FOR FURTHER ANALYSES

Other system alternatives and technologies not carried forward for detailed analyses were eliminated for a number of reasons. Some information on each of these is provided below.

2.6.1 ALTERNATIVES TO THE PREFERRED ACTION

2.6.1.1 All Space-Based System Alternative

A system alternative consisting only of SBS and SBI was considered but not carried forward. While this type of system could support the NMD mission, it is not considered a reasonable alternative at this time. Space-based systems have not matured technically or operationally. There are also general concerns regarding treaty compliance, and a lack of political support for an all space-based missile defense.

2.6.1.2 Space-Based Sensors and Interceptors and Ground-Based Sensors System Alternative

A system alternative consisting of Space-Based Sensors and Interceptors and Ground-Based Sensors was considered but not carried forward. Even without a detailed analysis, it was clear that the additional resources required for this alternative did not provide any justifiable advantage over the All Space-Based Alternative, which also was not carried forward.

2.6.1.3 TMD Deployment for NMD Purposes

The current ABM Treaty constrains testing and deployment of strategic ABM systems. If TMD elements were developed and demonstrated to have strategic defense capabilities, those elements would become subject to the ABM Treaty restrictions. Similarly, the treaty prohibits deployment of strategic ABM systems abroad; therefore, basing GBIs in Europe was not considered as an alternative for the theater defense mission.

2.6.2 TECHNOLOGY ALTERNATIVES

2.6.2.1 Directed Energy Weapons

Directed Energy Weapons (DEW) such as high-powered lasers or neutral particle beam weapons were eliminated because these technologies have not been demonstrated sufficiently to support further research and manufacturing development in the near term. Research might continue on

DEW development, but there is no requirement for directed energy systems in any alternative analyzed in this document.

2.6.2.2 Nuclear Materials

Policy direction since the initiation of the BMD program has been to develop a missile defense system without nuclear interceptor warheads. Although BMDO has sponsored research involving nuclear fuel (e.g., the TOPAZ Power Reactor Program), these programs are not incorporated into the BMD system architecture. Any future work in this area would be analyzed in supplemental or new environmental documentation.

2.7 COMPARISON OF ALTERNATIVES

Most activities under the Preferred Action or under the development and testing life-cycle phase of the System Acquisition Alternatives would not result in significant environmental impacts. The potential environmental consequences of each alternative are summarized and compared in Table 2-1. The summary and comparisons address the Preferred Action and the development and testing phase of the System Acquisition Alternatives. TMD research, development, and testing activities would proceed under all of the alternatives considered in this PEIS, including the Preferred Action. Because TMD impacts would not differ under any of the alternatives, they are not included in Table 2-1 or discussed in the following comparisons.

2.7.1 SUMMARY OF ENVIRONMENTAL CONSEQUENCES OF THE PREFERRED ACTION (EXISTING TECHNOLOGY READINESS PROGRAM)

Every effort will be made to locate activities in existing facilities to minimize disturbance to natural and cultural resources and impacts associated with these activities. Therefore, disturbance to natural and cultural resources and impacts associated with these activities would be minimal and would not result in any significant impacts. All activities would follow applicable regulations and established guidelines and management practices. These activities would generally occur within developed areas of existing installations or industrial parks. Any increased water demands could be readily met by existing supply systems, groundwater withdrawals, or alternative sources without significant environmental impacts.

The NMD System will not require a large force to carry out its mission. The current interceptor test plan would require very little maintenance or activity although minor staff augmentation could be necessary at certain installations. Substantial increases in regional population, and the accompanying increase in demand for water, housing, and other resources, would be unlikely.

Table 2-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 1 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Air Quality	Emissions from infrequent launch and test-fire exhaust clouds. Very slight emissions from handling and combustion of materials containing hazardous air pollutants.	Emissions could be slightly greater than under the PA and other alternatives since more launch vehicles would be required. Program is more extensive than under the PA or other alternatives.	Emissions could be slightly less than under the PA and other alternatives, since fewer launches would take place.	Emissions could be slightly greater than under the PA and Alternative B since there would be more launches. However, emissions could be less than under Alternative A since there would be fewer launches.
Upper Atmosphere	Limited use of Class I ozone-depleting substances with phaseout by 1996. Possible limited use of Class II ozone-depleting substances with phaseout by 2000. Very minor contribution to global warming. Very minor contribution to ozone depletion.	Emissions of ozone-depleting and global warming substances could be greater than under the PA and other alternatives since more launch vehicles would be required. Program is more extensive than under the PA.	Emissions of ozone-depleting and global warming substances could be less than under the PA and other alternatives since there would be fewer launches.	Emissions of ozone-depleting and global warming substances could be slightly greater than under the PA and Alternative B since there would be more launches. However, emissions of these substances could be less than under Alternative A since there would be fewer launches.
Electromagnetic Radiation (EMR)	Directional, high-frequency EMR from ground-based sensors (GBSs) and ground-entry points (GEPs) may affect occupational workers and wildlife.	Impacts could be equal to the PA and other System Acquisition Alternatives since GBS and GEP testing would be at similar levels.	Impacts could be equal to the PA and other System Acquisition Alternatives since GBS and GEP testing would be at similar levels.	Impacts could be equal to the PA and other System Acquisition Alternatives since GBS and GEP testing would be at similar levels.
Hazardous Materials and Waste Management	Accidental releases of hazardous materials are readily preventable for the PA and each alternative. Very limited generation of hazardous waste.	Generation of hazardous waste could be slightly greater than under the PA due to the programs being more extensive. Hazardous waste generation would be about the same as under the other System Acquisition Alternatives.	Generation of hazardous waste could be slightly greater than under the PA, but about the same as the other alternatives.	Generation of hazardous waste could be slightly greater than under the PA, but about the same as the other alternatives.

Table 2-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 2 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Noise	Infrequent, brief noise disturbances to residents close to existing Government launch and flight test installations.	Infrequent, brief noise disturbances could be slightly more numerous than under the PA and other alternatives due to an increase in launches.	Slightly fewer launches could have less impact than under the PA and other alternatives.	Infrequent, brief noise disturbances could be slightly more numerous than under the PA and Alternative B due to an increase in launches, but less than under Alternative A since fewer launches would take place.
Safety	Rigorous safety precautions necessary for occupational workers. Very little danger to public.	Somewhat more occupational workers requiring rigorous safety precautions than under the PA and other alternatives, since more extensive testing including flight test activities anticipated.	Slightly fewer occupational workers requiring rigorous safety precautions than under the PA and other alternatives.	Somewhat more occupational workers requiring rigorous safety precautions than under the PA and Alternative B, since more extensive testing activities anticipated. Fewer workers would require rigorous safety precautions than for Alternative A since less extensive testing activities anticipated.
Surface Water	Deposition from infrequent launch and test-fire exhaust clouds. Falling solid debris from infrequent launches and GBI test flights could require removal from near-shore and inland waters. Accidental contamination by spills, sedimentation, and runoff readily prevented.	Impacts to surface water could be slightly greater than under the PA and other alternatives since more extensive testing activities anticipated.	Impacts to surface water from exhaust clouds and falling debris could be slightly less than under the PA and other alternatives since less extensive testing activities anticipated.	Impacts to surface water from exhaust clouds and falling debris could be slightly greater than the PA and Alternative B since more extensive testing activities anticipated. However, impacts could be slightly less than under Alternative A since fewer launches would be required.

Table 2-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 3 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Groundwater	Water consumption too low to threaten most aquifers with overdraft, land subsidence, or saltwater intrusion . Accidental contamination readily prevented.	Slightly higher water consumption than under the PA and other alternatives since more extensive testing activities are expected.	Water consumption could be less than for the PA and other alternatives due to a lower level of testing.	Slightly higher water consumption than for the PA and Alternative B since more extensive testing activities are expected. Water consumption could be slightly less than under Alternative A since less testing is expected.
Visual Resources	Compatible with existing military, industrial, or isolated settings.	Compatible with existing military, industrial, or isolated settings.	Compatible with existing military, industrial, or isolated settings.	Compatible with existing military, industrial, or isolated settings.
Cultural Resources and Native Populations	Slight potential to disturb intact historic or surface or subsurface archaeological resources. Slight potential to interfere with Native American activities.	Slightly more potential for impacts to cultural resources than under PA and Alternative C, since this alternative has a more extensive testing program. Slightly less potential for impact to these resources than under Alternative B, since less land would likely be disturbed.	Slightly more potential for disturbing historic or archaeological resources than under the PA and other alternatives.	Slightly more potential for disturbing historic or archaeological resources than under the PA. Slightly less potential for disturbing these resources than for the other alternatives.
Biological Resources and Wetlands	Slight encroachment into undisturbed natural habitats and increase in noise impacts to wildlife. Wetland fill only under Section 404 permits (33 CFR 330).	Slightly more encroachment into undisturbed natural habitats could be possible under this alternative than under the PA and Alternative C but less encroachment than under Alternative B. Potential noise impacts could be slightly greater for this alternative than for the PA and other alternatives since there could be more launches. Wetland fill only under Section 404 permits (33 CFR 330).	Slightly more encroachment into undisturbed natural habitats and fewer noise impacts to wildlife could be possible under this alternative than under the PA and other alternatives. Wetland fill only under Section 404 permits (33 CFR 330).	Slightly more encroachment into undisturbed natural habitats could be possible under this alternative than under the PA but less than for the other alternatives. Potential noise impacts could be slightly greater than for the PA and Alternative B but less than for Alternative A. Wetland fill only under Nationwide General Section 404 permits (33 CFR 330).

Table 2-1. Summary and Comparison of Environmental Consequences from NMD Alternatives (Sheet 4 of 4)

Environmental Topic	Preferred Action (PA) (Continued Technology Readiness Program)	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative[1] (Alternative A)	All Ground-Based System Acquisition Alternative[1] (Alternative B)	Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative[1] (Alternative C)
Land Use	Would primarily utilize land already dedicated to similar activities. Would be compatible with adjacent land uses.	Slightly more land could be dedicated under this alternative than under the PA and Alternative C, since this alternative has a more extensive testing program. Slightly less land could be dedicated than under Alternative B. Would be generally compatible with adjacent land uses.	Slightly more land may need to be dedicated under this alternative than under the PA and other alternatives, since this alternative has a more extensive testing program. Would be generally compatible with adjacent land uses.	Slightly more land may need to be dedicated under this alternative than under the PA, since this alternative has a more extensive testing program. However, less land may need to be dedicated than for the other alternatives. Would be generally compatible with adjacent land uses.
Socioeconomics	Primarily use existing staff levels; some minor staff augmentation possible at some locations. Slight potential for localized economic and public service effects and short-term housing shortages.	Slightly higher level of staff augmentation could be necessary under this alternative than under the PA and other alternatives.	Slightly higher level of staff augmentation could be necessary under this alternative than under the PA. Slightly lower levels of staff augmentation could be necessary than for the other alternatives.	Slightly higher level of staff augmentation could be necessary under this alternative than under the PA and Alternative B. Slightly lower level of staff augmentation could be necessary than for Alternative A.
Geology, Soils, and Prime and Unique Farmland	Compatible with geologic setting. Limited extent of soil disturbance. Little potential to disturb prime and unique farmlands.	Slightly more soils could be subject to disturbance under this alternative than under the PA and Alternative C. Slightly fewer soils could be disturbed than for Alternative B. Little potential to disturb prime or unique farmland.	Slightly more soils could be subject to disturbance under this alternative than under the PA and other alternatives. Little potential to disturb prime or unique farmland.	Slightly more soils could be subject to disturbance under this alternative than under the PA. Slightly fewer soils could be disturbed than for the other alternatives. Little potential to disturb prime or unique farmland.

(1) Addresses only development and testing life-cycle phase

Source: Bailey, 1994b.

Small quantities of hazardous materials, such as rocket and missile propellants and industrial solvents, would be stored and handled. Routinely practiced measures typically outlined in spill prevention, control, and countermeasures plans for industrial facilities (including best management practices for handling hazardous materials) would prevent and/or mitigate accidental contamination of surface water and groundwater, soil, and other environmental resources. Routine stormwater management facilities are expected to prevent contamination of environmental media from runoff water, and routine erosion control practices typically outlined in soil erosion and sediment control plans are expected to prevent sedimentation of surface waters.

Test-firing of GBIs and launching of rockets to carry GBI test targets and space-based element test components aloft would generate short-duration exhaust clouds and brief periods of loud noise on established test ranges. Exhaust clouds from similar activities have been shown to have only minimal effects on air quality, the upper atmosphere, surface water, and soil surrounding the site of generation. Noise from these activities would be within applicable regulations and at established missile test ranges.

Solid debris from test-fired GBIs, spent targets, and jettisoned rocket stages could fall on land and in surface water under missile trajectories. These trajectories would generally be established over uninhabited desert or open ocean, where falling debris generally would not represent a public safety hazard or source of surface water contamination. Range recovery procedures would remove debris falling into inland waters which might result in localized surface water contamination and secondary impacts to vegetation and wildlife.

Most NMD electromagnetic radiation (EMR) generated by electric power lines, sensors, or communication systems would not adversely affect human health or wildlife, or interfere with electronic equipment. Procedures would be established to minimize effects on a site-by-site basis. Because this equipment would be oriented skyward, birds and other airborne fauna might be at particular risk. Ground personnel working in the immediate vicinity would be instructed to follow strict safety precautions to avoid EMR exposure. In addition, some precautions should be taken to minimize GEP EMR effects, although the magnitude of these effects is far less than those found associated with the GBS. The GEP EMR effects are associated with the GEP main beam, not sidelobes.

2.7.2 COMPARISON OF ENVIRONMENTAL CONSEQUENCES FROM THE SYSTEM ACQUISITION ALTERNATIVES WITH THOSE FROM THE PREFERRED ACTION

Although the development and testing phase of the System Acquisition Alternatives involves an increased scale of activity relative to the Preferred

Action, the overall conclusions concerning environmental consequences would not be different. There could be a greater number of activities associated with new construction, but the areas of disturbance would still be small and generally within existing industrial complexes. Staff augmentation and other resource demands, while possibly higher, would still be minimal. Likewise, while the number and types of rocket launches and test-firing activities could increase, noise disturbance and hazards from falling debris would still be minor. The same measures to prevent accidental contamination of various environmental resources would be equally effective.

2.7.3 COMPARISON OF ENVIRONMENTAL CONSEQUENCES FROM THE SYSTEM ACQUISITION ALTERNATIVES

The overall conclusions with respect to environmental consequences do not differ between the three System Acquisition Alternatives, even though the type, number, frequency and duration of activities in the development and testing phases of each of the System Acquisition Alternatives could differ. The overall effects from exhaust clouds and falling debris would be minimal and within existing regulations, even though the numbers of specific launch and test-firing activities could differ between alternatives.

2.7.4 COMPARISON OF ENVIRONMENTAL CONSEQUENCES AMONG LATER LIFE-CYCLE PHASES OF THE SYSTEM ACQUISITION ALTERNATIVES

The All Ground-Based System Acquisition Alternative would require basing a larger number of ground-based facilities than the GB/SB System Acquisition Alternative. Greater amounts of land and buildings would be used under the All Ground-Based System Acquisition Alternative, with a corresponding increase in potential for soil disturbance and encroachment into natural habitats. There would also be a greater potential for inducing regional population increases (and associated effects) by establishing bases for ground-based elements in isolated areas.

The Ground- and Space-Based Sensors and Ground-Based Interceptors System Acquisition Alternative would also involve more ground-based elements, but not as many as the All Ground-Based System Acquisition Alternative.

Chapter 2 References

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DoD, see U.S. Department of Defense.

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Chapter 3

Affected Environment

3.0 AFFECTED ENVIRONMENT

This chapter serves as the baseline against which potential environmental consequences from National Missile Defense (NMD) activities in the Ballistic Missile Defense (BMD) Program are assessed in Chapter 4. Affected environment discussions are provided for 14 topics that are the subject of the impact assessment in Chapter 4. Topics were chosen based upon the potential to be affected by the BMD activities, including both NMD activities (assessed in Chapter 4 of this PEIS) and Theater Missile Defense activities (assessed in an earlier PEIS [BMDO, 1993]). The large number of topics requiring detailed consideration reflects the diversity of activities that could occur over the course of the BMD Program. These topics include:

- Air quality (Section 3.1)
- Upper atmosphere (Section 3.2, Appendix H)
- Electromagnetic radiation (Section 3.3)
- Hazardous materials and waste management (Section 3.4, Appendix I)
- Noise (Section 3.5)
- Safety (Section 3.6, Appendix J)
- Surface water (Section 3.7)
- Groundwater (Section 3.8)
- Visual resources (Section 3.9)
- Cultural resources and native populations (Section 3.10)
- Biological resources and wetlands (Section 3.11)
- Land use (Section 3.12)
- Socioeconomics (Section 3.13, Appendix K)
- Geology, soils, and prime and unique farmland (Section 3.14)

The environmental setting discussions in this chapter are not directed to specific regions of influence (ROIs) defined for particular sites. Instead, the

discussions focus on defining environmental topics and identifying key issues and concerns that could form the basis of significant impacts.

Information is presented for the entire United States, including the Continental United States (CONUS), Alaska, Hawaii, and U.S. territorial islands. This region is termed the region of analysis (ROA) throughout the rest of this Programmatic Environmental Impact Statement (PEIS). The ROA also includes the U.S. Army Kwajalein Atoll (USAKA) facility in the Republic of the Marshall Islands, where many BMD activities could be conducted. The ROA is extended to include the entire upper atmosphere of the earth in Section 3.2.

Sections 3.1 through 3.14 each include four subsections:

- Definition of Topic. This subsection defines and briefly characterizes the topic and introduces key terms and concepts. Pertinent regulatory information necessary to understand the topic is also addressed, with detailed regulatory discussions provided in Appendix G.

- Issues and Concerns. This subsection outlines key issues and public concerns pertaining to the topic which could be the basis of significant environmental impacts attributable to BMD activities.

- Approach to Defining a Region of Influence. This subsection outlines how specific ROIs could be defined for the topic once a BMD activity is proposed for a specific location. Specific ROIs could be characterized as necessary in future environmental documentation.

- Range of Conditions. This subsection discusses the range of existing conditions which could be encountered once specific locations in the ROA are selected for BMD activities.

3.1 AIR QUALITY

3.1.1 DEFINITION OF TOPIC

Air quality, as addressed in this section, refers to the quality of air in the lowermost atmospheric level, the troposphere. Air quality in a given location is described by the concentration of various pollutants in the lower atmosphere. Stratospheric ozone levels and the earth's radiation balance (global climate change) are addressed in Section 3.2. Orbital debris is addressed in Appendix H.

The Clean Air Act of 1970 (CAA, 42 USC 7401 et seq.) established National Ambient Air Quality Standards (NAAQS) for those pollutants (termed criteria pollutants) that pose the greatest overall threat to air quality

in the United States. These standards were established to protect public health and the environment. Between 1970 and 1987, an evolutionary process occurred in the selection and definition of the criteria pollutants. In 1987, criteria pollutants were defined to include ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), lead (Pb), nitrogen dioxide (NO_2), and PM_{10} (particulate matter less than or equal to 10 microns in diameter). No other criteria pollutants have been added since 1987. Ozone, which is a major component of smog, is not emitted directly into the air but is formed through chemical reactions between volatile organic compounds and nitrogen oxides in the presence of sunlight.

The Clean Air Act requires that sources of air pollutant emissions comply with the air quality regulations and standards established by federal, state, and local regulatory agencies. These regulations focus on (1) the maximum allowable ambient pollutant concentrations resulting from source emissions, both separately and combined with other surrounding sources, and (2) the maximum allowable emissions from the source.

The Clean Air Act mandates that each state manage a regulatory program for air quality and monitoring deemed "equivalent" and "federally enforceable." Each state must prepare, or is required to have, a State Implementation Plan (SIP). The SIP details procedures by which areas designated as nonattainment can reduce emissions and improve air quality, with the goal toward attainment status.

The Clean Air Act Amendments of 1990 (CAAA) requires that all federal actions must be able to demonstrate and to ensure conformity to the applicable SIP. Conformity to the SIP means: (1) complying with the plan's objective of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards, and (2) ensuring that any planned activity will not cause or contribute to any new violation of a standard, increase the frequency or severity of any existing violation of a standard, or delay timely attainment of any standard.

The development of a conformity determination must be based upon an evaluation/comparison of the project's impacts, sources, emissions, pollutant concentrations, and mitigation measures with the appropriate element or component of the SIP. The rules and regulations of the respective state environmental regulatory agencies (through permit and enforcement programs) will ensure that the potential air quality impacts from planned or forecasted BMD activities will adhere to all federal and state air quality standards (FR, 1993a).

The NAAQS establish acceptable concentration levels for each criteria pollutant. Table 3-1 provides a listing of the presently established NAAQS (40 CFR 50) and health effects of each criteria pollutant. These standards are divided into two categories; primary and secondary. Primary NAAQS are

Table 3-1. National Ambient Air Quality Standards and Health Effects of Criteria Pollutants

	Primary (Health-Related) Standards		
Pollutant	Averaging Time Period	Standard Level Concentration (micrograms/ cubic meter)	Health Concerns
Ozone	Maximum daily 1-hour Average	235	Respiratory tract problems such as difficult breathing and reduced lung function. Asthma, eye irritation, nasal congestion, reduced resistance to infection, and possible premature aging of lung tissue.
Particulate Matter less than or equal to 10 microns in diameter	Annual arithmetic mean 24-hour	50 150	Eye and throat irritation, bronchitis, lung damage, and impaired visibility.
Carbon Monoxide	8-hour 1-hour	10,000 40,000	Impairment of ability of blood to carry oxygen. Cardiovascular, nervous, and pulmonary systems affected.
Sulfur Dioxide	Annual arithmetic mean 24-hour	80 365	Respiratory tract problems; permanent harm to lung tissue.
Lead	Maximum 3-month average	1.5	Mental impairment and brain damage, especially in children.
Nitrogen Dioxide	Annual arithmetic mean	100	Respiratory illness and lung damage.

Sources: U.S. 40 CFR 50; U.S. EPA Regulations on National Primary and Secondary Ambient Air Quality Standards, July 1, 1991 and 1988.

designed to protect human health, while secondary NAAQS are designed to protect public welfare, including crops, livestock, vegetation, buildings, and visibility.

The Clean Air Act Amendments of 1990 (CAAA) authorized the U.S. Environmental Protection Agency (U.S. EPA) to designate nonattainment areas for CO, Pb, O_3, PM_{10}, SO_2 and NO_2. Nonattainment areas are geographic regions not in compliance with NAAQS. The nation is divided into attainment and nonattainment areas by county or by Metropolitan Statistical Areas (MSAs). Areas designated as nonattainment for five of these pollutants are shown in Figures 3-1 through 3-5. The Los Angeles MSA is the only nonattainment area for NO_2.

Designation as a nonattainment area triggers control requirements designed to achieve attainment by specified dates. In addition, facilities that constitute major new emission sources cannot be constructed in nonattainment areas without permits that impose stringent pollution control requirements and sufficient offsets to ensure progress toward compliance.

For areas that are in compliance with NAAQS (attainment areas), Prevention of Significant Deterioration (PSD) regulations limit pollutant emissions from new sources and establish allowable increments of pollutant levels. New sources (including increased production levels) must conform with PSD requirements. PSD requirements are intended to protect areas without existing pollution problems. Three PSD classifications are designated based on criteria established in the CAAA. Class I areas include national wilderness areas, memorial parks greater than 2,024 hectares (5,000 acres), and national parks larger than 2,429 hectares (6,000 acres). Class II areas include all areas not designated as Class I. All areas in the U.S. not classified as Class I areas are now Classified as Class II areas. Class III areas, which would allow greater deterioration than Class II areas, have not been designated.

The CAAA also addressed Hazardous Air Pollutants (HAPs), consisting of toxic air pollutants broadly categorized as mutagens, carcinogens, and reproductive toxins. Health-based emissions standards, termed National Emissions Standards for Hazardous Air Pollutants (NESHAPs) exist for eight HAPs (40 CFR 61): arsenic, asbestos, benzene, beryllium, radon, radionuclides (other than radon), mercury, and vinyl chloride. For example, the corresponding NESHAP for industrial processing of beryllium is an emission rate not to exceed 10 grams in 24 hours, or a concentration measured at the site boundary not to exceed 0.01 microgram per cubic meter ($\mu g/m^3$) averaged over a 30-day period. A separate NESHAP applies to Beryllium Rocket Motor Firing. The U.S. EPA has not yet established emissions standards for other HAPs; however, some states have developed limiting criteria for other HAPs. Technology-based standards, termed

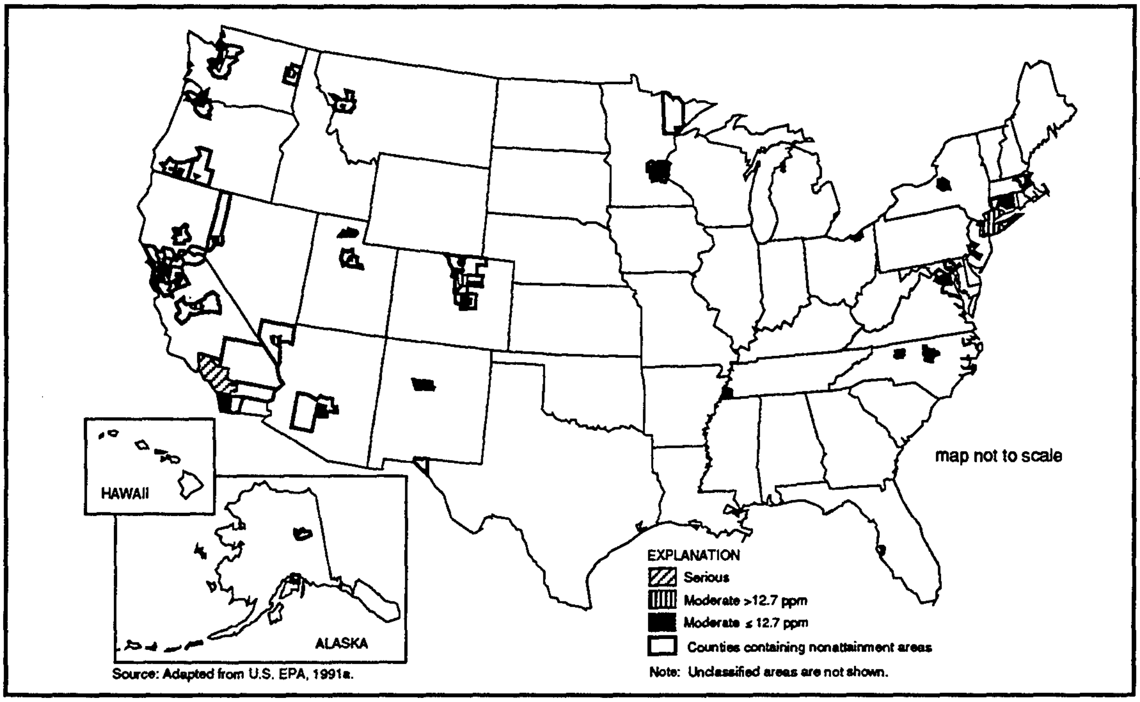


Figure 3-1. Areas Designated Nonattainment for Carbon Monoxide

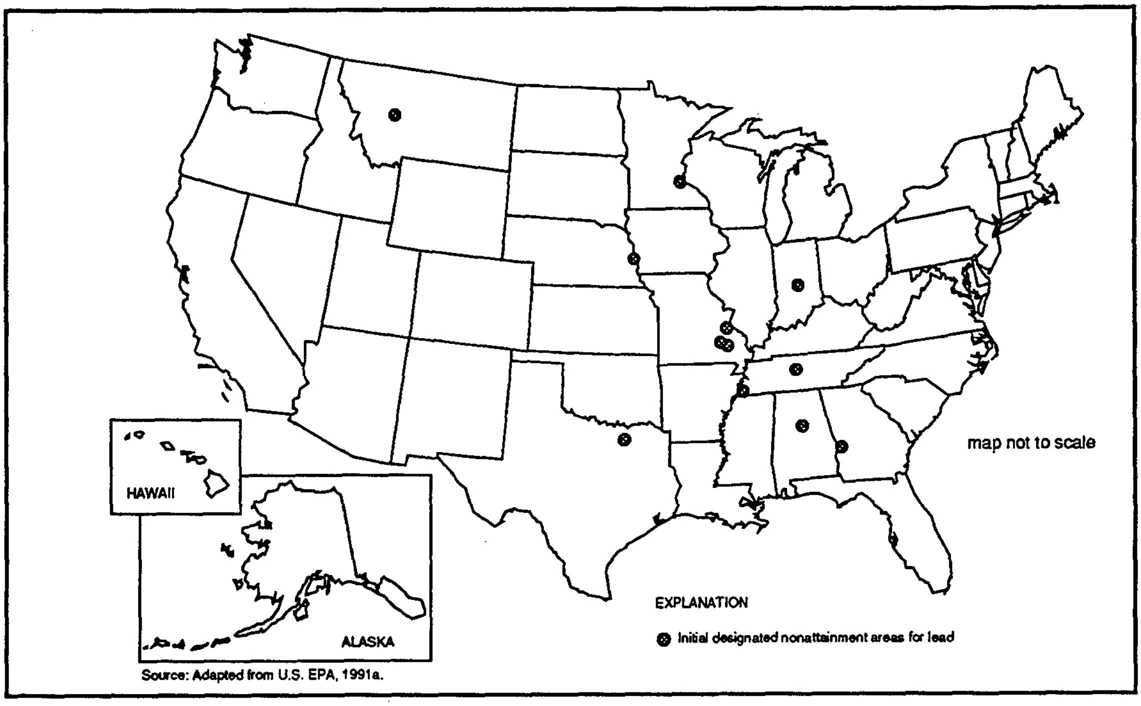


Figure 3-2. Areas Designated Nonattainment for Lead

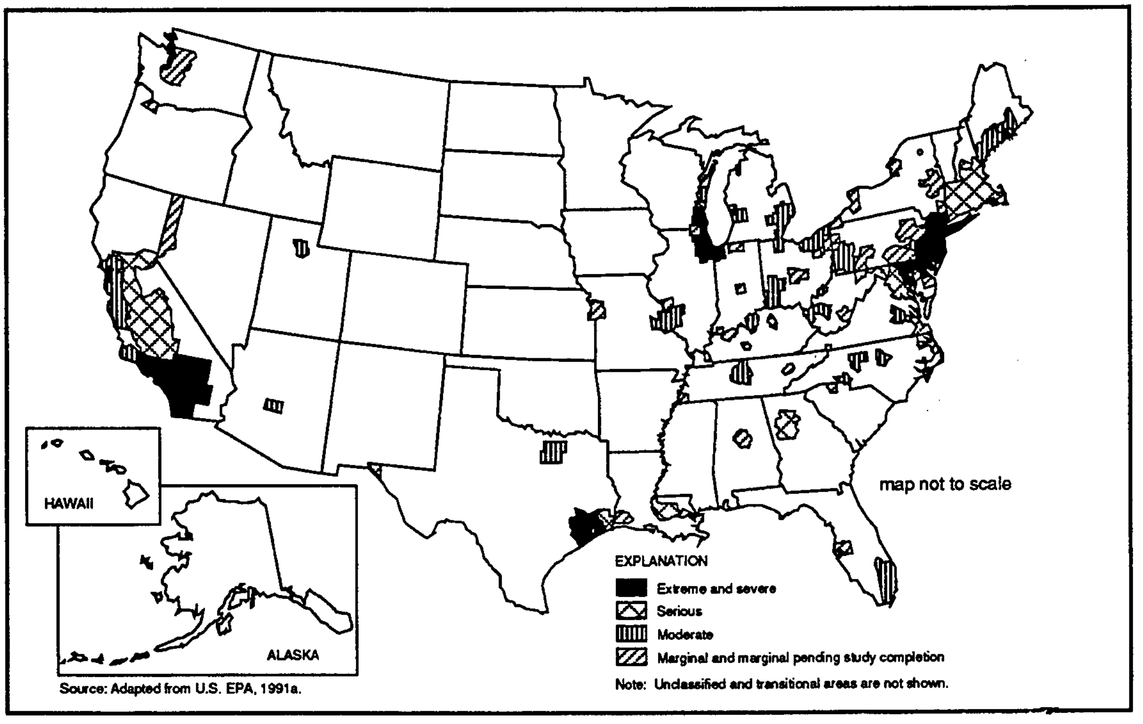


Figure 3-3. Areas Designated Nonattainment for Ozone

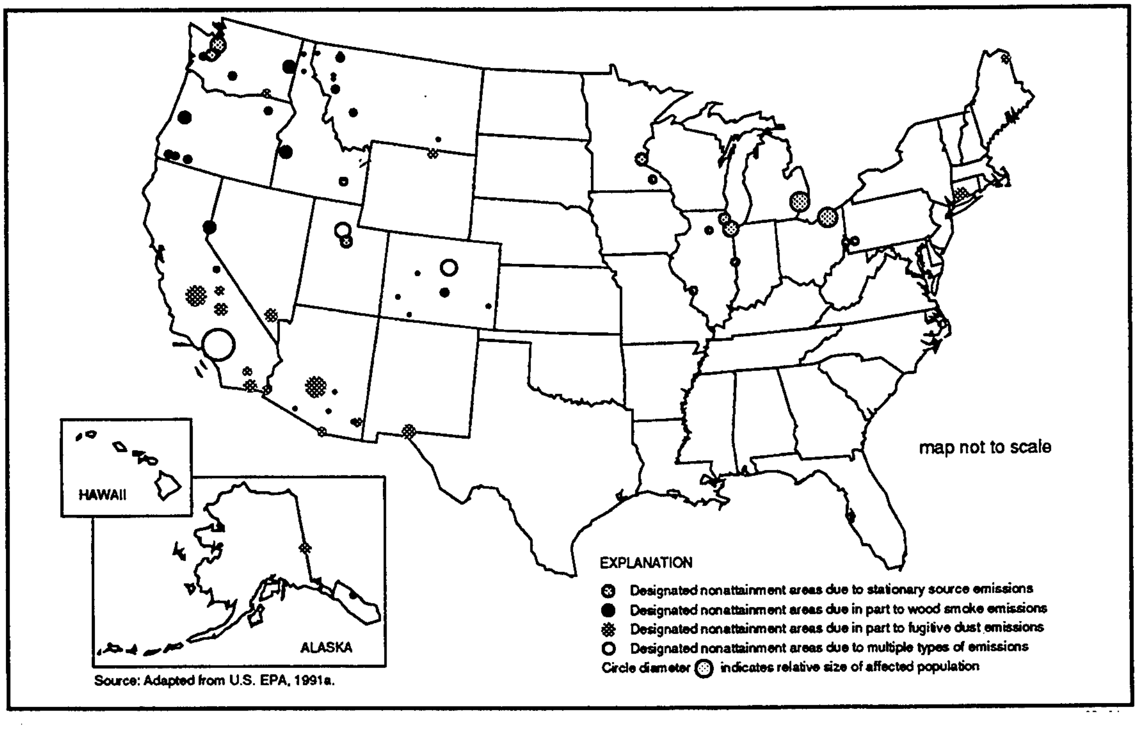


Figure 3-4. Areas Designated Nonattainment for PM_{10} Particulates, by Emission Type

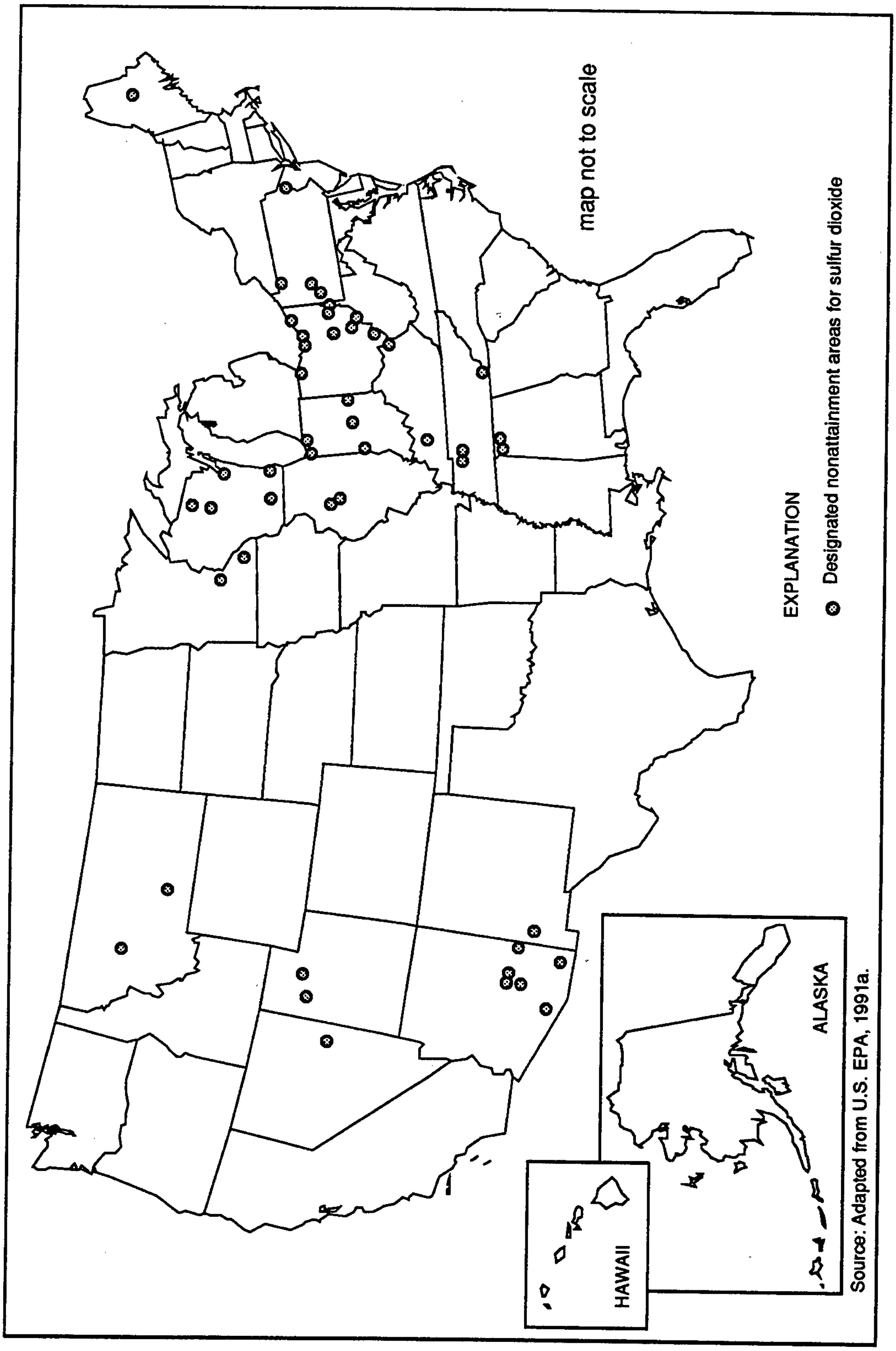


Figure 3-5. Areas Designated Nonattainment for Sulfur Dioxide

Maximum Achievable Control Technologies (MACTs), will eventually be developed for all HAPs.

3.1.2 ISSUES AND CONCERNS

Air emissions and air pollution can have a variety of adverse effects. Several issues and concerns include the following:

- Human health effects. The primary issue and concern pertaining to air quality is the effect of polluted air on human health. As indicated in Section 3.1.1, the purpose of the primary NAAQS is to protect human health. Table 3-1 lists the human health concerns associated with each criteria pollutant for which primary NAAQS have been established.

- Vegetation effects. Ground-level ozone is responsible for crop losses of several billion dollars in the United States and can cause foliar damage to trees and landscaping plants. Examples of other air pollutants that can kill or reduce the growth rates of trees and other plants include sulfur dioxide, nitrogen oxides, hydrochloric acid, and fluorides. Some air pollutants (such as lead) can be absorbed by crops and render fruits and vegetables toxic to consumers.

- Reduction in visibility. Many parts of the United States experience reduced visibility due to emissions in urban areas and from long-range transport of small particles (larger than 2.5 microns). In the eastern and southwestern United States, visibility reduction is attributable mostly to sulfates formed by release of sulfur oxides. In the northeastern United States, carbon particles contribute to visibility reduction.

- Acid rain effects. Sulfur dioxide and nitrogen oxides are contributors to acid rain, which can adversely affect both terrestrial and aquatic ecosystems. Acid rain has depleted fish populations in freshwater lakes and killed or injured trees. Acid deposition can reduce the availability of soil nutrients and kill nitrogen-fixing soil microbes. Acid deposition is also responsible for structural deterioration of monuments and buildings.

3.1.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for air quality would encompass those counties or MSAs potentially affected by each source of air emissions in the BMD Program. Definition of an exact ROI requires knowledge of specific pollutant types, emission rates and release parameters, proximity to other emission sources, and local and regional meteorological conditions. Existing air quality data can be obtained from the U.S. EPA or state regulatory agencies. In those areas where ambient data are unavailable, average background data can be obtained

from the U.S. EPA. Information on pollutant concentrations measured for short-term (24 hours or less) and long-term (annual) averaging periods can be extracted from monitoring station data.

3.1.4 RANGE OF CONDITIONS

According to U.S. EPA guidelines, an area with air quality better than NAAQS is designated as being in attainment; areas with worse air quality are classified as nonattainment areas. Pollutants in an area may be designated as unclassified when there is a lack of data for the U.S. EPA to form a basis of attainment status (U.S. EPA, 1991a). The present locations of nonattainment areas are indicated in Figures 3-1 through 3-5.

In specific ROIs, ambient concentrations of each criteria pollutant and each applicable HAP would be determined. Local air quality conditions are generally related to population density, manufacturing activities, topography, and area meteorology. The air quality at a given location can vary greatly with atmospheric conditions, depending upon the atmospheric stability and the mixing depth of the atmosphere. In general, the more stable the atmosphere and the lower the mixing depth, the poorer the air quality.

Many BMD activities would be located at existing facilities with emissions generated by automobile and other vehicular exhaust, airplane and rocket exhaust, and diesel-powered generator emissions. Some manufacturing facilities could be located in existing major manufacturing areas that are likely to be in nonattainment for one or more pollutants.

The CAAA requires that all federal actions conform to applicable federal, state, and local air quality regulations. Facilities with BMD activities will need to conform to the requirements of SIPs, which provide the regulations and guidelines for a state to reach attainment for the NAAQS. Federal actions which may produce emission levels above certain de minimis rates are subject to an analysis to determine whether they conform to the particular SIP; i.e., the actions that will be followed in a given state to meet applicable air quality standards. The de minimis rates are based on those defined in the CAAA as a major stationary source of emissions. This is to ensure consistency with that used for nonfederal actions. If a federal action is determined not to initially conform with the applicable SIP, a mitigation plan is to be prepared to reduce the consequences of the action. The mitigation plan is subject to review by the public as well as other federal and state agencies. See U.S. EPA's conformity regulations, 40 CFR 51.850 et seq. and 40 CFR 93.100 et seq. (FR, 1993a,b).

3.2 UPPER ATMOSPHERE

3.2.1 DEFINITION OF TOPIC

3.2.1.1 Stratospheric Ozone

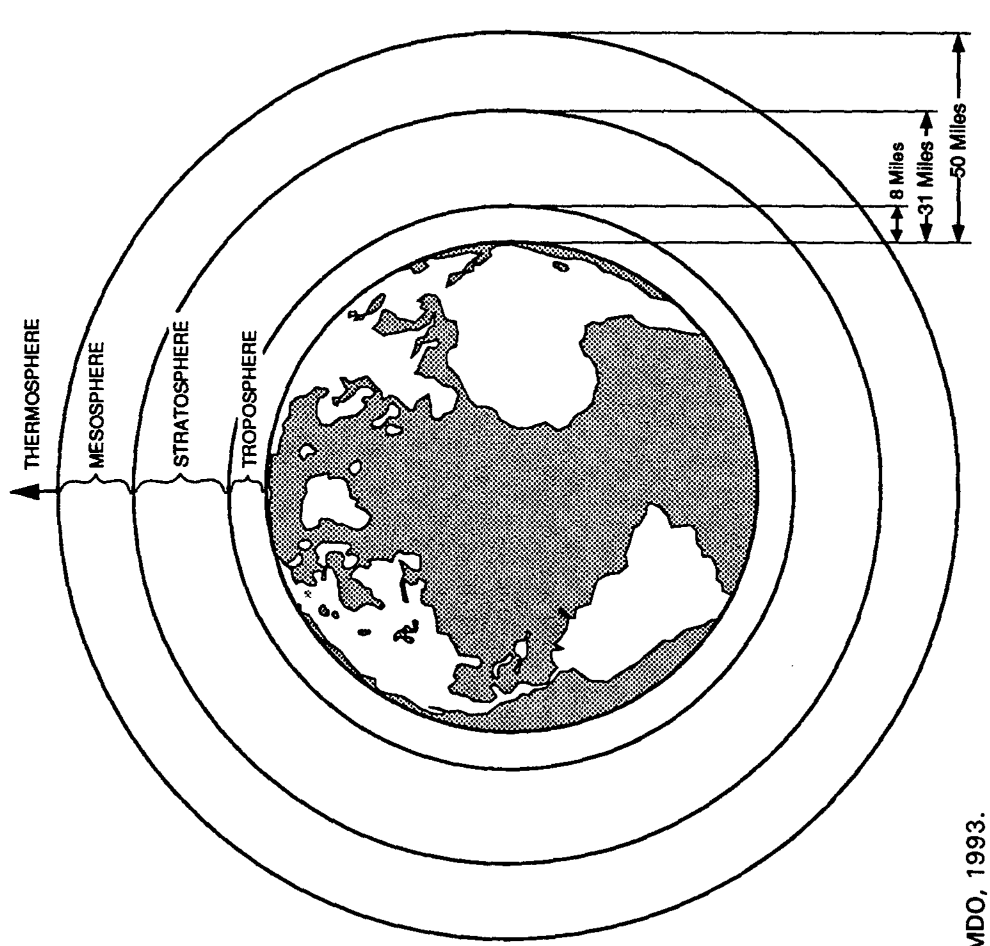
The stratosphere is located approximately 13 to 50 kilometers (8 to 31 miles) above the earth's surface (Figure 3-6). It is the main region of ozone production in the atmosphere. Although the tropical latitudes have fairly constant year-round ozone levels, temperate latitudes exhibit strong seasonal ozone variations with a maximum peaking in March/April and a minimum in October/November in the northern hemisphere, and the reverse variation in the southern hemisphere (Rowland, 1991).

Stratospheric ozone absorbs ultraviolet solar radiation, which is known to increase rates of skin cancer in humans and can be harmful to plant and animal life. Ozone is a triatomic molecule of oxygen. The concentration of ozone results from a dynamic balance between the ozone transported by stratospheric circulation and ozone destruction and production by chemical means. The dynamic nature of this balance means that ozone can vary on many timescales. Variations on timescales of up to 11 years have been observed, correlating with the solar cycle. Annual variations in the total ozone column can be as much as 1 percent, while day-to-day changes can be greater than 10 percent. Causes of temporal ozone variations include changes in ozone transport, changes in ozone chemistry, or a coupling of these processes. Variations in ozone concentrations may be solar-related or caused by other natural or man-induced variations in the chemistry of the stratosphere (AIAA, 1991).

The stratospheric ozone discussed above can be characterized as beneficial to the human environment. This is contrasted to the ozone produced near the surface of the earth formed through chemical reactions between precursor emissions of volatile organic compounds and nitrogen oxides in the presence of sunlight. High concentrations of ozone at ground level are a major health and environmental concern. (U.S. EPA, 1988; CEQ, 1989).

Amounts of stratospheric ozone depend upon a complex interplay between molecular transformations of chemical compounds and meteorological transport between different altitudes and latitudes. Chlorine is a particularly effective ozone destroyer (Rowland, 1991).

The capability for stratospheric ozone depletion by a particular organo-chlorine compound is basically a consequence of its ability to deliver chlorine to the stratosphere and is primarily a function of its number of chlorine atoms, atmospheric lifetime, and stratospheric reactivity. Ozone depletion potentials (ODPs) have been developed for organo-chlorine compounds. ODPs represent the relative amount of ozone depletion calculated in



Source: Adapted from BMDO, 1993.

Figure 3-6. Locations of the Atmospheric Layers

atmospheric models in comparison to the losses from an equivalent tonnage of CFC-11 set as 1.0 (Rowland, 1991).

Concerns about the ozone layer, and in particular the effect of man-made chlorine, led to the Montreal Protocol of 1987. Under the Montreal Protocol, more than 90 nations, including the United States, agreed to limit future production of ozone-depleting compounds (ODC). There are two classes of ODC. Class I substances include chlorofluorocarbons (CFCs), carbon tetrachloride, halons, methyl bromide, and methyl chloroform. Class II substances consist of hydrochlorofluorocarbons, or HCFCs. In the U.S., the CAAA established phaseout schedules that surpassed those established during the Montreal Protocol and subsequent international meetings. The term "phaseout" includes phaseout of production and phaseout of consumption. Production of Class I substances is scheduled for phaseout by January 1, 1996, with the exception of halons, production of which was phased out on January 1, 1994. Class II substances have a more gradual phaseout schedule, which begins in 2000 and extends to approximately 2020. The U.S. EPA can issue exceptions to the ban on use of some of these substances for medical, aviation safety, national security, and fire extinguishing purposes (Abbatt and Molina, 1993).

Executive Order 12843, signed by President Clinton on April 21, 1993, dictates that all federal agencies conform their procurement regulations and practices to the policies and requirements of Title VI of the CAAA. In compliance with this directive, all DoD contracts awarded after June 1, 1993 may not include a specification that requires the use of a Class I ozone-depleting substance, unless a waiver is granted. Waivers may be submitted by contractors who cannot find suitable substitutes for ODCs or ODC-containing equipment or cannot implement alternatives because appropriate equipment and process changes have not been made. Within the Air Force, the Air Force Federal Acquisition Regulation Supplement bans contracts requiring the use or delivery of Class I compounds, unless a waiver is processed through the Secretary of the Air Force for Acquisition, the Air Force Civil Engineer, or Air Force Logistics for final decisions (AFMC, 1993; FR, 1993c).

3.2.1.2 Radiation Balance/Global Climate Change

The temperature of the earth's atmosphere is determined by three factors: the sunlight it receives, the sunlight it reflects, and the infrared radiation absorbed by the atmosphere. The principal absorbers include carbon dioxide (CO_2), water vapor, nitrous oxide, CFCs, and methane. In general, the higher the concentration of these gases, the larger the absorption of infrared radiation and the warmer the earth's temperature. This phenomenon is commonly referred to as the "greenhouse effect."

3.2.1.3 Orbital Debris

Orbital debris (all earth-orbiting objects except active satellites) does not generally affect the human environment (that portion of the earth's atmosphere affecting life on earth or at the earth's surface where humans reside); consequently, analysis of potential effects of the BMD program production of, or impact on, orbital debris is not considered part of the issues and concerns of this PEIS. The problems of orbital debris are, nevertheless, considered important and are discussed in Appendix H.

3.2.2 ISSUES AND CONCERNS

3.2.2.1 Stratospheric Ozone

While considerable uncertainties remain in fully understanding the complex reactions that occur in the atmosphere that cause depletion of the stratospheric ozone layer, a growing body of evidence links CFCs and other chlorinated and brominated compounds to ozone depletion. A broad scientific consensus has emerged that continuing depletion of the ozone layer will lead to increased penetration of ultraviolet radiation with wavelengths shorter than 300 nm reaching the earth's surface. Health risks from ozone depletion include increases in cataracts and suppression of the human immune response system. Other risks include damage to crops and aquatic organisms and increased formation of ground-level smog (FR, 1993d). While it is true that a small amount of ultraviolet light is essential to health in aiding the production of Vitamin D, excessive exposure can be harmful.

3.2.2.2 Radiation Balance/Global Climate Change

During the past 150 years, combustion of fossil fuels has resulted in increasing concentrations of atmospheric gases that are believed to influence global climate. Some of the activities associated with the BMD Program could involve launches that use rocket fuels derived from fossil fuels. The partial products of combustion (burning) of the rocket fuel (which consists of hydrocarbons) are carbon dioxide and water. Both liquid and solid fuel propulsion systems emit water vapor and carbon dioxide, either directly from the nozzle or as a result of afterburning in the exhaust fumes. Hydrocarbon-based fuels include RP-1 (liquid fuel used in Atlas and Delta stage one engines) and the rubbery binders used in solid propulsion systems. For systems using RP-1, up to 70 percent of the exhaust stream can be carbon dioxide (BMDO, 1993).

3.2.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

The ROI for any BMD activity affecting the upper atmosphere and space would include all of the earth's upper atmosphere. The upper atmosphere

would be considered in its entirety rather than in terms of geographically regionalized ROIs.

3.2.4 RANGE OF CONDITIONS

3.2.4.1 Stratospheric Ozone

Scientists have been studying variations in stratospheric ozone levels over the last 20 years. In the early 1980s, computer models of the atmosphere suggested that ozone depletion from CFC use would amount to about 7 percent in 50 to 100 years. In 1985, scientists from the British Antarctic Survey reported that the ozone layer over Antarctica had shrunk each September and October since the late 1970s, which corresponds to the start of the Southern Hemisphere's spring season. In 1989, the first comprehensive research expedition of the Northern Hemisphere's polar region showed that the Arctic stratosphere is loaded in winter with the same destructive chlorine species which contribute to ozone depletion (Zurer, 1993).

In 1988, an exhaustive review of NASA satellite data concluded that, averaged over the globe, ozone had decreased about 2.5 percent between 1969 and 1986. A 1991 NASA research effort revealed that the magnitude of ozone loss was bigger, that the spatial extent was larger, and that the ozone depletion was persisting for a greater part of the year than had been previously recognized (Zurer, 1993). Extensive records of the spatial and temporal extent of ozone losses have been acknowledged by USEPA in implementing The Protection of Stratospheric Ozone, Final Rule of December 10, 1993.

In 1993, data from the Total Ozone Mapping Spectrometer (TOMS) onboard the Nimbus 7 satellite showed that global ozone levels for the winter of 1992 through spring of 1993 were 2-3 percent lower than in any previous year for these months and 4 percent lower than normal. Ozone levels for the northern mid-latitudes were about 10 percent lower than historical averages for this time of year and continued at low levels into the early summer. These findings may be a partial result of the eruption of Mt. Pinatubo in June 1991; the injection of aerosol particles into the stratosphere from volcanoes can provide favorable environments for accelerated depletion of ozone by chlorine or bromine species (FR, 1993d).

A United Nations Environmental Program (UNEP) assessment estimates that for every 1 percent decrease in ozone, biologically damaging ultraviolet radiation will increase 1.3 percent. Evaluations of impacts from increased ultraviolet radiation at a given location must consider the time of year and the latitude. Ultraviolet radiation naturally varies with time of year, latitude, and altitude. For example, four times as much ultraviolet radiation reaches the earth's surface at Philadelphia at 10 AM in the summer than in the

winter. Southern latitudes receive more ultraviolet radiation than northern latitudes. (Zurer, 1993).

3.2.4.2 Radiation Balance/Global Climate Change

The U.S. EPA estimates that the atmospheric level of CO_2 has risen approximately 20 percent in the past 180 years. Current annual emissions of CO_2 are estimated at 24,240 million tons from man-made sources and 1,100,000 million tons from natural sources. Atmospheric levels of other gases have also risen. The industrial world shares the greatest responsibility for these increases. Burning of fossil fuels (hydrocarbons) oxidizes carbon and releases CO_2 (SDIO, 1991a).

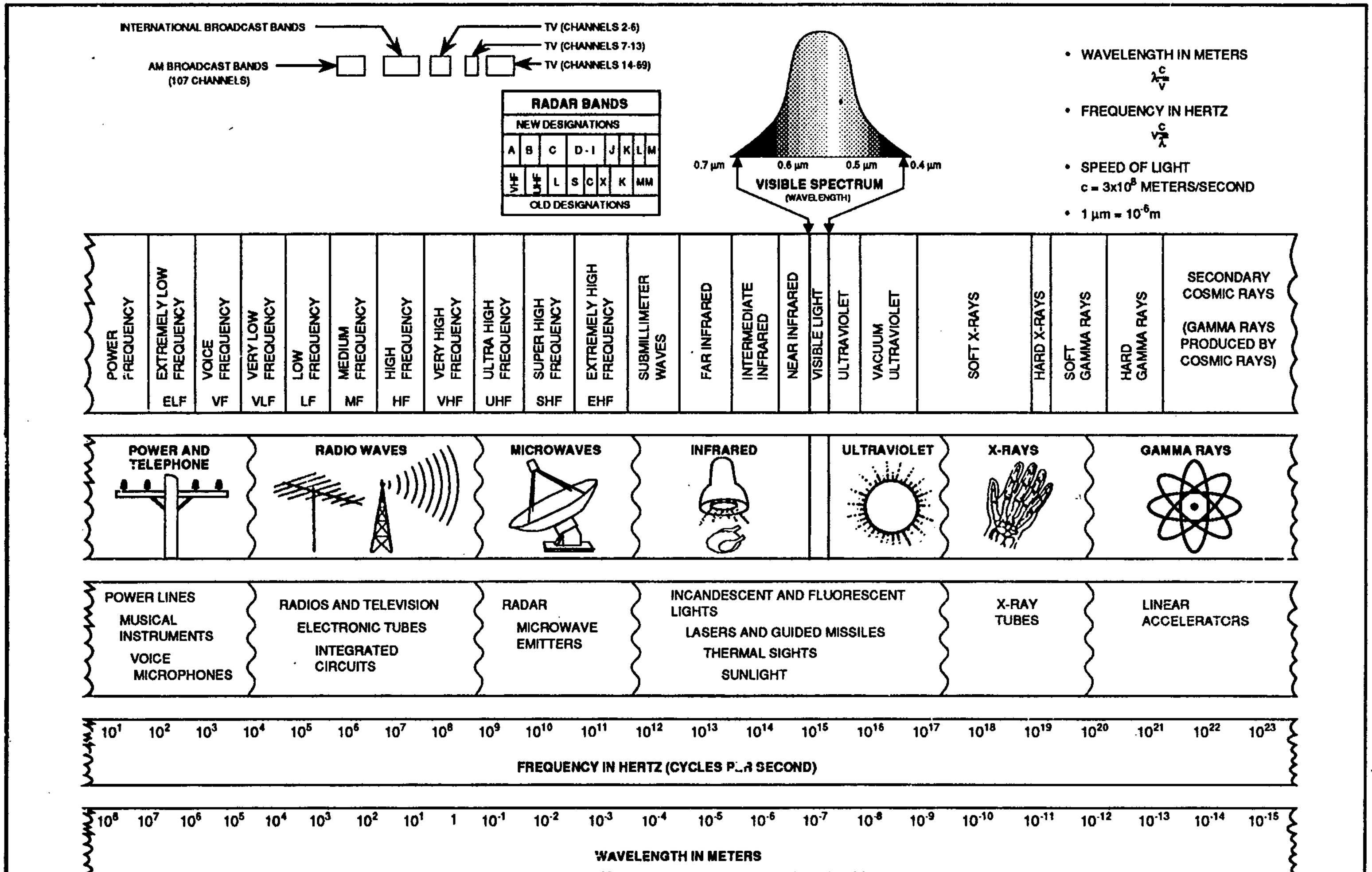
3.3 ELECTROMAGNETIC RADIATION

3.3.1 DEFINITION OF TOPIC

Electromagnetic radiation (EMR) is associated with the interaction between an electric and a magnetic field. Whenever electric charges are present, a corresponding electric field occurs. Electric fields are usually measured in volts/meter (V/m). Electric charges in motion, as in the case of an electric current, creates an associated magnetic field at right angles to the electric field. The international system of measurement (SI) unit of the magnetic field is the weber per square meter (Wb/m^2) also called the tesla (T). Electric and magnetic fields which vary in time are described by their frequency, which is the number of times that the field oscillates per second. The unit for frequency is cycles per second or Hertz (Hz). Radio waves, visible light, radars, x-rays, and gamma rays are all examples of electromagnetic fields (EMF) at various frequencies (Figure 3-7).

The creation of a magnetic field by a changing electric field (and vice versa) results in the transport of energy through space in the form of EMR. The magnitude of the induced field is proportional to the time-rate-of-change of the induced field. Extremely low frequency fields (ELF), which range from 3 Hz to 300 Hz (power lines for example), change very slowly, so that induced field intensities are small. However, electric (or magnetic) fields in the radio frequency range (10,000 Hz to 300 GHz) can create substantial magnetic (or electric) fields with some of the energy propagating as electromagnetic radiation. Electromagnetic radiation travels in a vacuum at the speed of light, c, which is $3x10^8$ meters/second. This radiation may also be described by the wavelength, λ, which is related to the frequency, f, by $\lambda f=c$.

Radio frequency EMR can be measured by its power density. Power density is a quantity which describes the rate that energy is transmitted through a unit area and is usually measured in watts per square meter (W/m^2). EMR in the low frequency range (below approximately 10,000 Hz) have negligible



Source: Adapted from SDIO, 1991b.

Figure 3-7. Electromagnetic Spectrum

power densities and are usually measured by the strength of their associated magnetic fields in Teslas.

To measure the amount of radio frequency EMR absorbed by a biological system, the units are often defined in terms of the specific absorption rate (SAR). The common unit for SAR is watt per kilogram (W/kg). SARs are a more effective way to measure the effect of EMR on the human body because it takes into account how much of the EMR is actually absorbed by the biological tissue. The SAR is dependent on many factors including distance from the source, frequency of the EMR, the body's alignment to the waves, and size of the person.

Sources of EMR from BMD activities include radios, radars, and microwave sources used to communicate, acquire and track objects, and control operations; devices used to test the survivability or "hardness" of components and systems, including lasers operating in non-ionizing regions of the spectrum and electromagnetic pulse simulators; and EMR-emitting devices used in fabricating components and systems, such as laser welding and cutting tools.

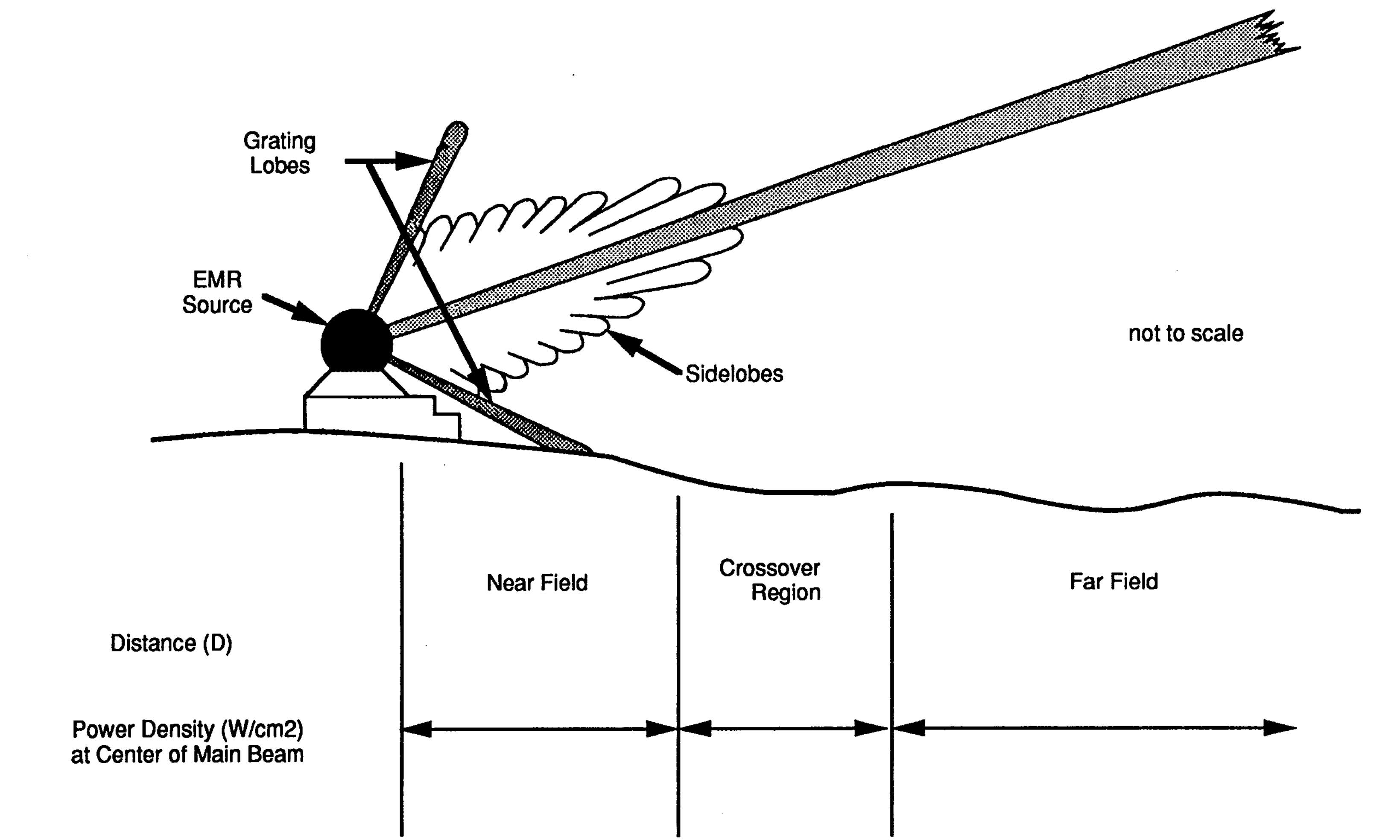
Some of the BMD components make use of phased-array antennas, which produce directional EMR in the radio frequency range. Directional EMR comprises a main beam of EMR, associated sidelobes, and grating lobes (Figure 3-8) The main beam extends in the direction in which the EMR source is pointed. The sidelobes are of weaker power densities and surround the main beam. The grating lobes are secondary beams whose energy is generally above sidelobe energy but below main beam energy.

The power density in the main beam emitted from a directional EMR source varies with distance from the source. In the near field, power density is directly dependent on the transmitter power and inversely proportional to the area of the antenna aperture. In the far field, power density is directly related to the transmitter power and the antenna gain factor, and inversely proportional to the square of the distance from the source (Figure 3-8). The area between the near field and the far field is termed the *crossover region*. In the crossover region the power density varies and can approach near-field or far-field values depending on the distance from the source.

3.3.2 ISSUES AND CONCERNS

Non-ionizing EMR arises from electromagnetic waves with frequencies between 1 and approximately 10^{16} Hz. Issues and concerns regarding non-ionizing EMR include:

- potential hazards to human health and safety
- potential effects on wildlife and domestic animals



Source: Adapted from USASSDC, 1993b.

Figure 3-8. Field and Lobes of Directional Electromagnetic Radiation

- potential ignition during fueling operations
- inadvertent detonation of electroexplosive devices (EEDs) and ordnance (ammunition)
- potential interference to electronic systems (e.g., navigation, communication, and radar systems)

EMR reacts with these media differently, depending on its frequency, strength, and time variation. Each of these issues and concerns is discussed below.

3.3.2.1 Potential Hazards to Human Health and Safety

The health effects of exposure to EMR are complex and not completely understood. While EMR associated with BMD activities is not capable of ionizing biological tissues (USASSDC, 1993b), the absorbed energy associated with exposure can lead to molecular agitation. This action can lead to sufficient molecular friction to heat tissue; if the energy absorption rate exceeds the body thermoregulatory capacity, the exposed tissue temperature can rise. If the exposure continues, physiological damage can result. The common points for damage are the eyes and the skin. The heat induced in the body by repeated non-ionizing EMR exposures at short intervals is not cumulative in a thermal sense; upon termination of the EMR exposure, body tissues will slowly resume their pre-exposure temperatures. These comments are limited to EMR typically well above the frequency level of 10,000 Hz. This exposure level is well above the limits contained in various exposure standards.

In 1966, the American National Standards Institute (ANSI) issued its first standard recommending maximum exposure values for electromagnetic fields (USASSDC, 1993b). This early guide on exposure was relatively simplistic, in that it set a power density limit of 10 mW/cm^2 across the frequency range 10 megahertz (MHz) to 100 gigahertz (GHz).

Since 1966, the ANSI standards have undergone significant revisions. The new standards reflect consideration of SARs and take into account time averaging. When exposures can be limited to 6-minute intervals, exposure levels higher than the standard are permitted, provided that the exposure is controlled so that the average value over any 6-minute period does not exceed the standard. In September 1991, the Institute of Electrical and Electronics Engineers (IEEE) adopted a major revision of the ANSI standards. This revised standard (IEEE C95.1-1991), which has been adopted by ANSI, specifies field strength and induced current limits (for frequencies below 100 MHz) for both controlled environments (i.e., where entry into the radiation hazard area is controlled) and uncontrolled environments.

In the past two decades, several studies have addressed the potential health effects of ELF radiation and EMR radiation in the lower frequency ranges (NRPB, 1992). The associated studies have looked at exposures in residential settings and suggest that human exposure to magnetic fields associated with home wiring and appliances may affect human health at levels considerably lower than those that could cause cellular heating (below approximately 10^5 Hz).

A number of studies have addressed the potential effects of ELF and radio frequency radiation. Seven studies of radio frequency radiation and, specifically, radar emissions most closely pertain to the frequency emissions that could occur due to related BMD activities (Lilienfield et al., 1978; Robinette et al., 1980; Milham, 1982, 1985a, 1985b, 1988a, 1988b; Hill, 1988; State of Hawaii, 1986). These studies suggest that a variety of tumors or precancerous growths may occur with chronic exposure to low levels of pulsed and unpulsed radio frequency emissions; however, none of these studies provides statistically valid evidence to support a correlation between radio frequency emissions and cancer.

In late 1990, the U.S. EPA's Office of Research and Development released a review draft report titled "Evaluation of the Potential Carcinogenicity of Electromagnetic Fields" summarizing preliminary findings on the effects on humans of various types of electromagnetic radiation, including radar (U.S. EPA, 1990). The report included no definitive findings regarding the health effects of electromagnetic fields. Studies to date have not been conclusive. In some cases results have not been reproducible between studies, while in others there is a lack of exposure data that demonstrate dose-response effects, or the data are confounded by other variables that mask possible effects of exposures to radio frequency emissions. U.S. EPA has reached no conclusions that would cause the current exposure standards to be changed. The draft document has been reviewed by U.S. EPA's Science Advisory Board, and U.S. EPA is now taking comments from the public. After public comments and the results of certain ongoing studies have been incorporated, the document will be issued in final form in 1994.

Pending results of continuing research, human exposure to radio frequency emissions from radars should be controlled to below 5 mW/cm^2, which is below the power densities permitted by the ANSI standards. If research identifies a need to change standards for exposure to EMFs, these standards will be promulgated and operations modified appropriately.

Steady-state EMR can also adversely affect cardiac pacemakers and other electronic medical devices. Non-electronic prosthetic devices manufactured from magnetic materials can be adversely affected. Safety measures such as shielding are necessary to protect human health from steady-state electromagnetic fields above certain strengths.

3.3.2.2 Potential Effects on Wildlife and Domestic Animals

Research on power line-generated electric and magnetic fields has not shown any adverse impacts to wildlife behavior or health. Representative research to support this finding includes studies of the effects of 500-kilovolt (kV) transmission line rights-of-way have on large and small mammals. Other research has studied the effects from a 1200-kV prototype transmission line (few transmission lines exceed 750 kV) on small animals for a period of several years. None of these studies found any adverse impacts to animals from electric or magnetic fields created by power lines (U.S. DOE, 1989).

Radar-generated EMR is also a concern for animals, especially airborne animals such as birds, bats, and insects, that could be in the pathway of the radar main beam, sidelobes, or grating lobes. Research concerning radar-generated EMR has shown that thermal-related effects are the most common associated impact to biological systems. Acute exposures to EMR with frequencies above approximately 100 kilohertz (kHz) normally induce an increase in body temperature or responses to minimize heat load. Other research concerning the nonthermal effects of EMR on animals indicates that microwave EMR is not mutagenic and consequently is not likely to be carcinogenic (NRPB, 1992).

Studies of microwave EMR and animal behavior indicate that animals avoid EMR as a result of a thermoregulatory response in normal or warm environments or tend not to avoid it in cold environments in order to gain warmth (Earth Technology Corporation, 1993). Other studies have not shown conclusive evidence of any relationship between EMR and elements of animal behavior such as nesting and feeding.

Research on the biological effects of EMR has shown that biological impacts (i.e., body temperature increases) could begin to occur at exposures to average power densities above 1 mW/cm^2. The degree of impact would depend on the power density of the EMR, the distance from the beam source, the length of exposure, the SAR of the animal, the animal's ability to regulate body temperature, and weather conditions related primarily to temperature and humidity.

3.3.2.3 Potential Ignition During Fueling Operations

Fuel ignition potentially can become a problem when EMR currents, which can be induced in metallic objects by intense EMR fields, lead to possible arcing and sparks. This phenomenon has been observed under contrived test conditions during refueling operations (USASSDC, 1993b). Ignition may occur if the proper mixture of fuel vapor and air exists at the point where the spark occurs, but this is considered unlikely.

3.3.2.4 Inadvertent Detonation of Electroexplosive Devices and Ordnance (Ammunition)

EED detonation (e.g., inadvertent firing of meteorological rockets during arming operations) is related to electromagnetic field-induced currents that flow in the electrical leads connected to the explosive device. Currently, Air Force Regulations define the limit for EEDs as an instantaneous power density of 10 mW/cm^2 at the electrical leads (AFR 127-100).

3.3.2.5 Potential Interference with Communication and Electronic Systems

In recent years, the introduction of high technology digital avionics systems that control critical functions in aircraft has raised the issue of possible interference with these systems by high-intensity radar fields (HIRF). Critical systems are defined as those that would result in the aircraft's crashing if they were to be rendered inoperative by HIRF. Examples of these types of systems include the Electronic Flight Instrument System, Full Authority Digital Engine Control, Inertial Reference System (IRS), and Auxiliary Control System. The use of digital electronics in these systems may make them particularly vulnerable to HIRF. If aircraft in flight are illuminated at close range by the radar, malfunctions induced in avionics equipment are possible.

The Electromagnetic Compatibility Analysis Center (ECAC) studied the potential for impacts on communications systems from EMR emitted from a prototype test Ground Based Radar (GBR). Proposed BMD activities and alternatives may include Ground Based Sensors (GBSs) similar to the prototype test GBR. These studies examined the potential for interference from the GBR to communication-electronic systems which operate both within and outside of the GBR frequency band due to high power effects (HPE) and, for other radar systems, the number of desired pulses that might be detected by the radars leading to objectional obscuring of the visual images on the radar screen (USASSDC, 1993b).

In the ECAC analysis, information on the GBR antenna gains for the main beam, the peak grating lobes, and the average sidelobes was used to compute expected field magnitudes in the vicinity of the GBR. The analysis, conducted for the actual systems at United States Army Kwajalein Atoll (USAKA), revealed the potential for HPE to affect amplitude modulation, frequency modulation, and television reception due to the presence of grating lobes in the distance range of 2.1 to 4.5 kilometers. With systems such as walkie-talkies, ECAC estimated that some degree of interference could exist within 30 kilometers, under the maximum grating lobe condition (USASSDC, 1993b).

3.3.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for EMR would encompass all areas within a determined distance around each potential EMR emitter in the BMD Program. The distance would be a function of the transmitter power of the EMR emitter, the angle above the horizon in which the emitter is pointing, and the area of the antenna aperture. The ROI would include at least all areas around the EMR emitter where the power density could exceed federal guidelines or state standards. If there were no applicable guidelines, the ROI would include at least all areas around the EMR emitter where the power density could exceed 5 mW/cm^2 averaged over any 6-minute period.

3.3.4 RANGE OF CONDITIONS

Baseline EMR levels vary greatly even within localized geographic regions. The total amount of EMR at any one location would be difficult to measure over time owing to variations in the field. The internal exposure to EMR that could affect human and biological receptors is also virtually impossible to assess. The distance between the source and the receptors, the presence of shielding (such as trees and buildings), and the presence of metal objects (which can increase electromagnetic field strength) could all affect the internal exposure levels to the receptors.

Areas with higher population densities generally would have a greater number of EMR emitters (such as radio and television stations, communications equipment, high-voltage power lines, weather radar, and industrial equipment) than do areas of lower population density. However, areas near a large industrial complex or near a Federal facility with a concentrated EMR source (such as communications equipment, radars, or specialized research facilities) could have higher baseline EMR levels than would be expected from a consideration of population density alone.

3.4 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

3.4.1 DEFINITION OF TOPIC

The terms *hazardous materials* and *hazardous wastes* include those substances meeting specific criteria in federal statutes and regulations. These substances have hazardous physical and chemical properties and/or have high toxicities. The BMD Program potentially will include activities such as research, manufacturing, construction, demolition, rocket launching, support activities, and facility maintenance that could be expected to use hazardous materials and generate hazardous wastes. Based on regulatory definitions, substances are hazardous materials prior to and during their use. After their use when they are no longer needed, hazardous materials become hazardous wastes. Appendix I, Table I-1 presents typical hazardous materials and wastes associated with the BMD Program.

3.4.2 ISSUES AND CONCERNS

Issues and concerns related to hazardous materials and waste management are closely related to a diversity of environmental topics covered in this PEIS. For example, releases of hazardous materials and waste to the air and surface water are covered in the sections that address those environmental media (Sections 3.1 and 3.7, respectively). Also, the risks of hazardous materials and waste handling experienced by workers are addressed in the section on safety (Section 3.6). These issues and concerns will also be identified in this section, together with other issues and concerns not addressed elsewhere.

Some problems associated with hazardous materials and wastes can be addressed by the implementation of pollution prevention practices throughout BMD activities. Additionally, there are Office of the Secretary of Defense and Ballistic Missile Defense Organization (BMDO) policies and directives addressing hazardous materials and waste management. The primary issues and concerns associated with these materials include the following:

- Risks associated with the use and handling of hazardous materials or wastes. The use and handling of hazardous materials and wastes could result in a potential health risk to workers. Additionally, the handling of hazardous materials and wastes releases varying quantities of hazardous constituents to the environment. For example, solvents evaporate during use, and incineration of hazardous wastes releases hazardous constituents to the air.

- Accidental releases of hazardous materials and wastes to the surrounding environment. Accidental releases can occur through transportation accidents, equipment failures, human error, and improper storage. The risk to humans resulting from the release of hazardous materials depends on the amount and toxicity of the wastes, the media into which they are released, and the proximity of the release to human populations. The risk to natural resources resulting from an accidental release would depend on the amount and toxicity of the wastes, the media to which they are released, and the proximity and type of species affected by the release.

- Disposal of hazardous waste. Despite the implementation of pollution prevention, waste minimization practices, and treatment to stabilize or detoxify waste, some hazardous waste would require disposal. Disposal of hazardous waste could result in an unquantifiable potential risk to human health and the environment. The future long-term integrity of disposed waste forms or the ability of a disposal facility to isolate hazardous waste constituents cannot be predicted with certainty. Potential

releases of hazardous constituents from disposal facilities could negatively impact both human health and the environment.

3.4.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for hazardous materials would include all areas potentially subject to release of hazardous materials or wastes from each BMD activity. The extent of the ROI would vary according to the physical and chemical characteristics of the materials in question. The pathway through which the materials typically travel determines the geographical area potentially affected.

A number of site-specific factors could also determine the size of the affected area, and include:

- Atmospheric conditions. Materials are more volatile at higher temperatures. Hazardous materials are more likely to enter the environment via evaporation in hot weather. Also, steep temperature gradients enhance the vertical mixing of air, and thus the dispersion of contaminants. Wind intensifies this dispersion and transports airborne contaminants. Sunlight exposure increases volatilization rates and can result in the formation of different chemical compounds. Humidity contributes to the corrosivity of containers in which materials are stored. Rainfall can increase the transport of hazardous materials to groundwater and surface water supplies.

- Surface water hydrology. The size, depth, currents, and other hydrological characteristics of rivers, lakes, estuaries, and other surface water bodies affect how readily water pollutants can spread from their sources. For example, the ROI for most inland (nontidal) rivers would be the reach downstream from a pollution source. The length downstream would primarily be a function of current and depth. In contrast, the ROI for tidal rivers could include reaches both downstream and upstream from the pollution source.

- Groundwater hydrology. Hydrologic characteristics of individual aquifers (or portions of aquifers), such as the porosity of the rocks and soils comprising the aquifer, influence the hydraulic conductivity and, hence, the ability of contaminants to spread throughout the aquifer(s). The ROI for certain aquifers with very low hydraulic conductivity could be very localized. For other aquifers, it could be very broad. Aquifers protected by very impermeable overlying materials, termed confined aquifers, could be excluded from the ROI despite lying beneath contaminated ground surface.

- Soil type. Soil type affects the speed at which released contaminants can reach groundwater supplies (Section 3.8).

Sandy soils are more permeable and allow more seepage, while clayey soils are less permeable and retard seepage.

3.4.4 RANGE OF CONDITIONS

A few generalized observations concerning broad geographic regions within the ROA are possible, as follows:

- Desert environments common to the southwestern United States are generally hot, dry, and sandy. Volatility and evaporation of hazardous compounds could be a greater concern in these areas than in other areas.

- The eastern United States is temperate and humid, and its soils are more clayey than other regions. Corrosivity and surface runoff of contaminants are of greater concern in this region than in other regions. Population densities are higher, particularly on the east coast, contributing to a greater risk to human health from exposures or releases.

- The northern United States is colder and accidentally released gases would not mix as rapidly as in warmer climates. The gases could therefore spread close to the ground surface, where people would be exposed, rather than rapidly escaping to upper air layers. The shallow soils and glacial till soils in previously glaciated soils could retard seepage of spilled materials.

- The midwestern United States is temperate with moderate precipitation. High organic content of soil promotes binding of contaminants to the soil through adsorption.

- Florida and the Gulf Coast are characterized by hot weather, heavy rainfall, sandy soils, and shallow groundwater tables. These conditions promote the rapid subsurface transport of contaminants.

- The Pacific Islands have a hot climate and very heavy rainfall. Soils derived from volcanic rock tend to be relatively impermeable while those derived from coral and similar calcareous deposits tend to be more permeable.

3.5 NOISE

3.5.1 DEFINITION OF TOPIC

Noise is sound that interferes or interacts negatively with the human or natural environment. Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy, a medium for transmitting the sound wave, and a receptor.

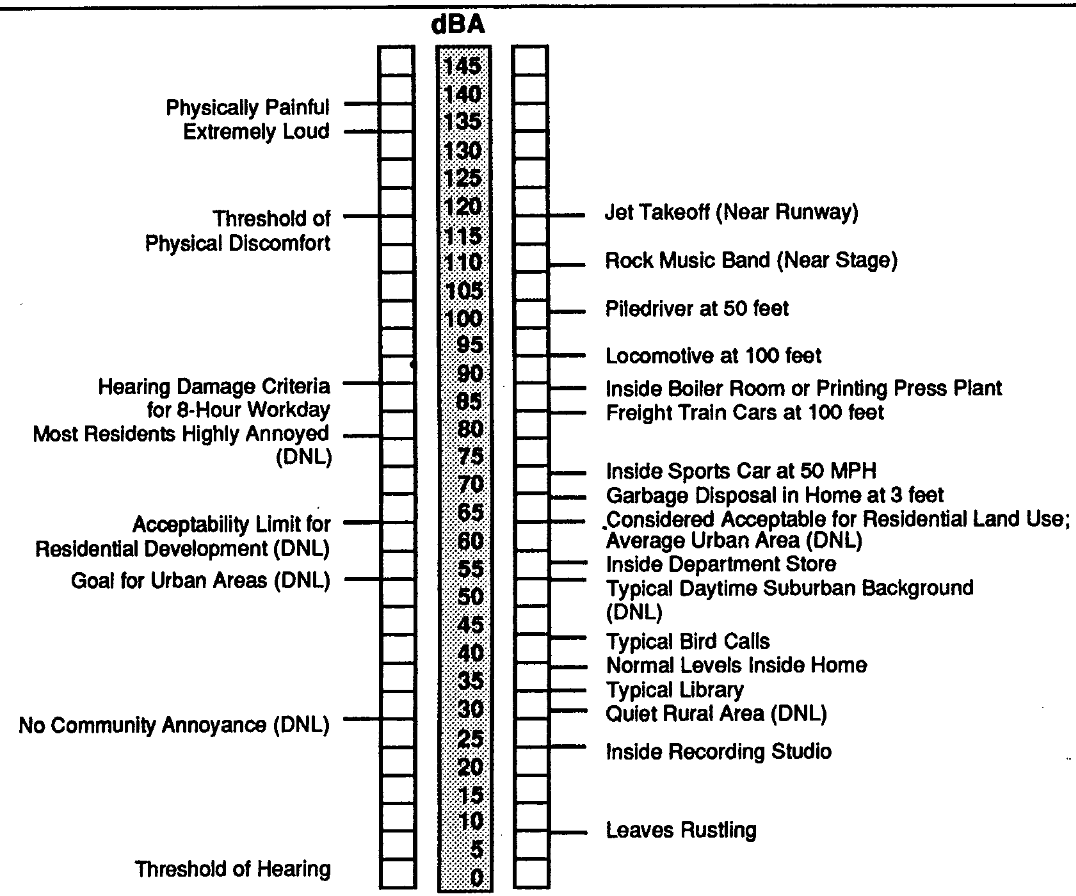
Sensitive noise receptors can include occupants of any facility requiring mostly quiet conditions (such as a residence, school, hospital, or church); workers in a workplace where noise can affect performance or cause hearing damage; and noise-sensitive wildlife species. The smallest change in noise levels detectable by the human ear is approximately 3 decibels (dB). An increase of 10 dB is roughly equivalent to a doubling in the perceived sound level.

The propagation of sound is affected by various factors including meteorology, topography, and barriers. Under free-field conditions, where there are no reflecting surfaces other than the ground and a loss-free atmosphere, sound decreases at a rate of 6 dB for each doubling of distance. This is commonly known as the inverse square law. For example, a sound level of 70 dB at a distance of 30.5 meters (100 feet) would decrease to 64 dB at 61 meters (200 feet), and 58 dB at 122 meters (400 feet) (Harris, 1979).

For acoustic measurements addressing effects on humans, the overall sound level measurements are usually compensated by an "A"-weighted filter which accounts for the hearing response characteristics of the human ear. Sound pressure level measurements made using the "A"-weighted filter are denoted dBA. Figure 3-9 shows typical noise levels of familiar noise sources and public responses.

The effects of noise on a receptor are related to the magnitude of the sound, the time of day, and the duration of the sound. To take into account that noise varies considerably over the course of a day, the U.S. EPA developed a noise descriptor, the day/night average sound level (DNL), that is an average of sound energy levels throughout the 24-hour day. A 10-dB penalty is added to the nighttime sound levels between 10 p.m. and 7 a.m. to account for the greater sensitivity to noise during the nighttime hours. However, for short-duration noise, the DNL descriptor is not particularly relevant, since a very loud short-duration noise is averaged with the remainder of the daily noise. The sound exposure level (SEL) is a useful descriptor to measure the intrusiveness of sound, combining sound level and sound event duration. The SEL is a measure of the total A-weighted sound energy of an event normalized to a 1-second event (BMDO, 1993).

Sonic booms may occur from an object moving at supersonic speed such as a rocket or airplane. A sonic boom is an impulsive sound resembling thunder experienced on the ground and generated by the shock-wave pattern formed around the object. Characteristics of the shock pattern are influenced by flight path characteristics (e.g., altitude, speed, acceleration, angle of attack, flightpath curvature) and characteristics of the object (NASA, 1978; Harris, 1979).



Sources: BMDO, 1993; National Academy of Sciences, 1977; Federal Interagency Committee on Urban Noise, 1980; Harris, 1979; U.S. EPA, 1971; 29 CRF 1910.95.

Figure 3-9. Typical Noise Level of Familiar Noise Sources and Public Responses

3.5.2 ISSUES AND CONCERNS

Noise is a prevalent concern associated with military training, testing, construction and operation of production facilities, and decommissioning activities and is perhaps the most common pollutant in governmental and industrial workplaces. Noise can affect both humans and wildlife. Issues and concerns include the following:

- Community Exposure. The consequences of noise levels on people outside the workplace include physiological effects (e.g., hearing loss), behavioral effects (e.g., interference with speech, sleep, and performance), and subjective effects (e.g., annoyance).

- Worker Exposure. Effects of noise levels on people in the workplace (workers exposed to high noise levels as a part of their job duties) include hearing loss and interference with activities. Noise in the workplace may also be a safety concern.

- Wildlife Exposure. Noise levels have both physiological and behavioral effects on wildlife.

- Domestic Animal Exposure. Noise levels also have physiological and behavioral effects on domestic animals.

- Historic and Other Structure Exposure. Noise and vibration on structures, especially those with low frequency content, can cause structural vibrations that result in structural damage.

3.5.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for noise would include any areas in which noise levels could be directly or indirectly affected by any activity. The ROI would include sites of each proposed activity as well as areas near these sites where activities might increase noise levels, including areas of human habitation and habitats of noise-sensitive wildlife. The outward extent of the ROI from any potential source of noise would depend upon the magnitude of the noise, the sensitivity of surrounding areas to noise, and noise-attenuating factors such as topography, meteorology, and barriers such as vegetation.

3.5.4 RANGE OF CONDITIONS

Acoustic conditions in the ROI vary with the type of land use, population, density, types of noise sources, and other factors. BMD activities would be located in a variety of acoustical settings. These settings could range from very remote sites with low ambient sound levels typical of uninhabited or

wilderness settings to noisy industrial settings. Some activities may occur in rural areas or near residential areas.

The DNLs typical of residential land uses range from about 35 dBA for a rural residential area to 72 dBA or higher for an urbanized area (U.S. EPA, 1974), as shown in Table 3-2.

Table 3-2. Typical Ranges of Residential Noise Levels

Description	DNL (dBA)
Rural Residential	35-50
Quiet Suburban Residential	48-52
Normal Suburban Residential	53-57
Urban Residential	58-62
Noisy Urban Residential	63-67
Very Noisy Urban Residential	68-72

Source: U.S. EPA, 1974.

Higher noise levels can be expected to occur in more industrialized areas. Rural, agricultural, or desert locations would be expected to have ambient sound levels in the range of DNL 35 to 50 dBA. Lower sound levels may occur where there is little wind, insect activity, or other natural sounds.

Existing test ranges and launch facilities have major sources of noise including aircraft operations, rocket testing, and rocket launches. Noise levels vary with the type of activities at these facilities. Sonic booms are experienced near some of these facilities. Department of Defense (DoD) facilities that generate high outdoor noise levels have established programs with the goal of ensuring compatibility with land uses in the vicinity of these facilities. These programs include the Air Installation Compatible Use Zone program for DoD air installations and the Installation Compatible Use Zone program for Army installations and facilities.

3.6 SAFETY

3.6.1 DEFINITION OF TOPIC

Safety, as addressed in this section, is defined as the protection of workers and the public from hazards. The total accident spectrum encompasses not only injury to personnel but also damage or destruction of property or products.

While certain outcomes originating from technological experimentation can be anticipated, they cannot be predicted with certainty. Considering the unpredictability of any research and development action, such as the BMD Program, and considering both the safe and harmful components of risk, uncertainty cannot be totally eliminated, and not all accidents can be avoided (Wildavsky, 1988).

In general, potential hazards associated with the BMD Program can be placed into two major categories: substances and physical agents (SDIO, 1992). Substances include elements, compounds, mixtures, and materials of complex composition. From the standpoint of worker and public health and safety, harmful substances can be classified as toxic or hazardous. Toxic substances directly affect human physiology, as in poisoning the central nervous system. Hazardous substances are explosive, flammable or ignitable, corrosive, or reactive. Several substances used in activities similar to those in the proposed BMD Program are identified and discussed briefly in Appendix J (also Section 3.4, Hazardous Materials and Waste Management).

Physical agents include non-ionizing EMR, static electric and magnetic fields, ionizing radiation (radioactivity), laser beams, noise, explosions, deorbiting/suborbital debris, and extreme cold. EMR and noise are discussed in Sections 3.3 and 3.5, respectively. Several common hazards normally associated with activities similar to those in the BMD Program are listed in Appendix J.

3.6.2 ISSUES AND CONCERNS

Considerable attention must be paid to the safe production, transport, storage, use, and disposal of toxic and hazardous substances. Consideration must be given to materials that, in case of accident, could be released to the workplace or the external environment, where they could be widely dispersed. The following five considerations must be addressed:

- Exposure pathways. Toxic substances can poison workers and the public by ingestion, inhalation, or dermal contact. Controlling each of these exposure pathways is critical to preserving health and safety. Where possible, activities involving toxic materials must take place within structures or under conditions that minimize the potential for accidental releases to the environment. Considerations include special handling of toxic substances, control of indoor air and air emissions, and regulation of water discharges.

- Distances. Siting decisions must consider the distance from toxic substances to the workers and the public. Additionally, meteorological conditions and the proximity of water and other environmental media must be considered. Routes selected for

the transportation of toxic and hazardous materials must minimize the potential for public exposure.

- Disposal. The disposal of toxic and hazardous wastes presents an additional set of considerations (such as a choice among disposal in a landfill, incineration, or recycling to retrieve all or some of the active components). The method of disposal of toxic and hazardous wastes is a major consideration both in the selection of materials and in siting analyses.

- Occupational worker health. Continuous programs to monitor for health threatening exposures or contaminants, as well as the health of workers exposed to toxic materials, are necessary. A baseline physical examination of each worker must be performed, and the physical condition of the worker must be periodically measured against the baseline.

- Synergism. Properties of individual components (materials or substances) can be markedly affected by the presence of other materials (synergism). Synergistic effects of toxic materials must be considered. The health threat of two separate toxic substances may be considerably greater if one is introduced in the presence of the other.

Examples of safety concerns include EMR (also discussed in Section 3.3), radioactive materials, lasers, explosive and ignitable materials, and debris hazards.

- EMR. EMR over a large spectrum of frequencies can be considered from the viewpoints of both low-frequency and higher frequency systems. Low-frequency systems include effects that arise, or could arise, from the distribution or generation of alternating current. Related to these are static and alternating magnetic and electric fields (such as those potentially generated by accelerator operation), high-voltage equipment, energy storage (including superconducting magnetic energy storage), hypervelocity projectiles, electromagnetic pulse programs, and radar programs over a number of frequency bands. High-frequency systems can cause physiological effects (see Section 3.3.2). For directed electromagnetic energy (as in the case of laser beams and radar beams), attention must be given to siting, azimuthal, elevation, and range considerations.

- Radioactive materials. Radioactive materials could be used for hardness testing. X-ray generating machines are available for above-ground hardness testing. Most industrial X-ray machines operate at levels too low to affect the surrounding facility area. Particle accelerators are used to generate and accelerate beams of high-energy neutral and charged particles for use in directed

energy weapons and to produce X-rays for use in hardness testing. Radioisotopes are another source of controlled radiation for hardness testing. Nuclear reactors may be used as radiation sources for hardness testing. Nuclear-powered generators are being considered for BMD satellites (U.S. OTA, 1988). Existing regulations govern the adequate shielding of workers, containment of radioactive gaseous materials until suitable decay has taken place, monitoring of workers and discharge points (such as vent stacks and cooling water discharges), and transportation.

- Lasers. BMD activities utilize lasers for a variety of purposes. Chemical and free-electron lasers are candidate directed-energy weapons which produce highly energetic beams of non-ionizing EMR. Active sensor systems could use laser radiation to detect and track targets. Prototypic laser weapons and lasers used for hardness testing utilize the most powerful lasers. Attention must be given to the distance between personnel and lasers to prevent eye injuries (U.S. OTA, 1988; American Physical Society, 1987).

- Explosives/cryogenics. Explosive and ignitable materials are found in petroleum, oil and lubrication, rocket propellant, and some cryogenic materials. Cryogenic materials must be stored under conditions that ensure the integrity of containers, with adequate provisions for the potential explosive release of extremely cold materials which could also be asphyxiants or highly reactive substances. An example is liquid oxygen, a cryogenic material used for rocket fuels and fuel cells and for the cooling of accelerators and optical arrays. Any compressed or condensed gas could explode and rupture its container. Attention must be given to the distance between the physical agent and the receptor.

- Launch Vehicle Debris. Hazards from debris, such as jettisoned rocket stages, shrouds, and other material, exist during every normal launch sequence. Debris could also result from launch and early-ascent accidents. These hazards are controlled by determining a launch hazard area and a downrange impact area and restricting access to them through standard range clearing and access control operations. Launch vehicle debris can include pieces of metal, unburnt or burning solid propellant, intact fuel tanks, nozzles, and other components. Some pose a serious fire and explosion hazard. Additional potentially hazardous physical agents can be found in Appendix J, Table J-2.

- Reentry Debris. Reentry occurs when an orbiting spacecraft or debris from an orbiting spacecraft comes back into the Earth's atmosphere. Any object placed in Earth orbit will eventually de-orbit and reenter the atmosphere; this includes launch and

breakup debris of satellites and spent rocket stages. Spacecraft tend to spiral slowly toward the Earth's surface. When objects reenter the atmosphere, their orbits decay rapidly and many of them burn up prior to impacting the Earth's surface; however, some objects survive the reentry process. Identified reentry debris has included such diverse items as tank pieces, nozzle pieces, small spherical gas tanks, plastic shrouds, and other fragments (U.S. DOT, 1988). Additional information regarding reentry risk and impact dispersion can be found in Appendix H.

3.6.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for safety would include all areas within which workers or the public could be exposed to hazards originating from any activity. For certain activities, the ROI could be confined to certain rooms or other areas within a building. For other activities, the ROI could take in entire buildings, installations, or portions of installations. The ROI could encompass areas of land surrounding the buildings or installations housing certain BMD activities and also large areas downrange from launch sites.

3.6.4 RANGE OF CONDITIONS

The range of conditions under which a particular risk to worker and/or public safety from a given component or system could exist would not vary appreciably from site to site or from facility to facility. Only by considering specific facilities selected for BMD activities can a range of conditions for safety be developed. Specific hazards to personnel at the kinds of Government installations and contractor facilities suitable for BMD activities could include the following:

- Toxic and hazardous material handling, machining, polishing
- Cryogenics material operations
- High-voltage electrical hazards
- X-rays and other EMR-induced hazards
- Exposure to lasers and "hardening" experiments
- Fuel transfer operations
- Rocket/booster/missile/target final assembly
- Rocket/booster transport
- Test missile/target system erection on the launch platform
- Launch operations
- Launch debris/explosion debris
- Intercept debris

3.7 SURFACE WATER

3.7.1 DEFINITION OF TOPIC

Surface water includes rivers, streams, lakes, ponds, reservoirs, wetlands, estuaries, and oceans. Wetlands are defined in Section 3.11.1. Estuaries are coastal bodies of water that are mixing zones for freshwater and seawater and whose salinity and volume fluctuate with the ebb and flow of the tides. Oceans in the ROA include the Atlantic and Pacific Oceans and the Gulf of Mexico.

3.7.1.1 Surface Water Quality

The quality of water in a surface water body is a function of natural factors (such as precipitation, runoff, and groundwater discharge) and of human factors. Two major types of water pollution are generally recognized: point source pollution, involving distinct outfalls from discrete identifiable sources; and nonpoint source pollution, involving diffuse releases from several sources over a large area (U.S. EPA, 1988). Because nonpoint sources are more difficult to control, they are generally considered to be a more serious problem (Stein, 1992).

To protect human health and aquatic biota, the U.S. EPA has developed surface water quality criteria, which define the characteristics of a water body that are the minimum necessary for a designated use. Individual sets of criteria have been established to protect aquatic biota in freshwater and marine surface water bodies, to protect the health of humans who come in contact with the water, and to protect the health of humans who consume fish and other edible organisms taken from the water (U.S. EPA, 1991b).

The discharge of pollutants to surface water requires a permit under the National Pollutant Discharge Elimination System (NPDES). NPDES permits include effluent limitations specifying the maximum concentrations of specific pollutants that may be present in discharge water.

3.7.1.2 Surface Water Quantity

The principal factors contributing to the flow rate (discharge) of rivers and streams include groundwater discharge (base flow, created where the water table intersects the ground surface) and precipitation. Most precipitation reaching rivers and streams is in the form of runoff (overland flow). The region contributing overland flow to a river or stream is its watershed (Hynes, 1970; Wetzel, 1993). The principal factors contributing to the volume of lakes and ponds include precipitation falling directly on the water surface, runoff, discharge from streams and rivers, and groundwater discharge.

Surface water is subject to two principal types of uses: offstream and instream. Offstream uses involve withdrawal of water for uses such as irrigated agriculture, municipal water supply, or industry. Instream uses are those that do not involve water withdrawal. Examples include navigation, recreation, aquatic habitat management, and hydroelectric power generation (Lamb and Doerksen, 1990).

3.7.1.3 Floodplains

The base floodplain (100-year floodplain) is defined in Executive Order 11988 (Flood Management) as the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, and encompassing (at a minimum) areas subject to a 1 percent or greater chance of flooding in any given year. The critical action floodplain (500-year floodplain) includes those areas subject to a 0.2 percent or greater chance of flooding in any given year. The Water Resources Council Guidelines for Implementing Executive Order 11988 (43 CFR 6032) recognize two general types of floodplains: riverine and coastal. Riverine floodplains are valley areas adjacent to streams and rivers that are subject to flooding whenever the carrying capacity of the channel is exceeded. Coastal floodplains are areas adjacent to large lakes, estuaries, oceans, and other bodies of standing water that are subject to flooding from landward flows of water caused by unusually high tides, waves from high winds, storm surges, or tsunamis (large oceanic waves associated with strong earthquakes or other geologic disturbances).

The 100-year floodplain is divided into two parts: the floodway and the floodway fringe. The floodway consists of the channel of the river or other watercourse plus any adjacent lands that must be kept free of encroachment to discharge the 100-year flood, without increasing the height of the floodwater by 30.5 centimeters (1.0 foot). Some states have adopted more restrictive standards for defining the floodway. The floodway fringe includes the remainder of the 100-year floodplain (USGS, 1991).

3.7.2 ISSUES AND CONCERNS

3.7.2.1 Surface Water Quality

Surface water quality can be best evaluated in terms of whether the subject water body supports the designated use assigned by the states under the Clean Water Act (CWA) (33 USC 1251 et seq.). Examples of common uses assigned to individual water bodies include drinking water supply, cold water fishery, and contact recreation.

Examples of adverse effects resulting from impaired surface water quality include the following:

- Rendering Water Unsuitable for Drinking. Drinking water supplies must meet the maximum contaminant levels (MCLs) established for contaminants in the Primary Drinking Water Standards (40 CFR 141). Although most water can be adequately treated, pollution of surface waters designated as drinking water supplies can increase treatment costs or lead to their closure.

- Rendering Water Unsuitable for Swimming or Fishing. An estimated 25 percent of river and stream miles in CONUS, Hawaii, and Puerto Rico did not fully meet swimmable goals under the CWA in 1991, and 20 percent did not fully meet fishable goals (U.S. EPA, 1992). Of particular concern are those contaminants (such as mercury and polychlorinated biphenyls (PCBs) that can accumulate in very high concentrations in the tissues of predators, including many sport fish species.

- Toxicity to Aquatic and other Biota. Some contaminants are directly toxic to aquatic biota. Many organic contaminants, while not directly toxic, are subject to rapid microbial decomposition, depleting dissolved oxygen in surface water and thereby suffocating aquatic biota. The eutrophication of surface waters, whereby the influx of plant nutrients results in increased biotic productivity, can also impact certain aquatic biota and be detrimental to human uses as well. Contaminants could also be toxic to riparian vegetation or terrestrial wildlife that drink from affected surface waters. Indirect effects on other animals are possible if they feed on contaminated plants or wildlife.

Although coastal waters are not important domestic or industrial water sources, their contamination adversely affects aquatic biota, commercial fisheries, and recreation. Estuaries and other near-shore coastal waters serve as natural sinks for contaminants carried downstream by freshwater tributaries. Coastal areas have experienced unusually heavy rates of urban development in recent years with accompanying erosion, sedimentation, and stormwater runoff (CEQ, 1989).

3.7.2.2 Surface Water Quantity

Surface water quantity issues and concerns generally pertain to withdrawal of water from inland freshwater bodies to meet offstream water uses. Some examples of issues and concerns related to the offstream use of surface water include the following:

- Competition with Commercial Instream Water Uses. Denial of adequate instream flow for certain instream water uses such as

navigation and hydroelectric power generation can have direct economic consequences.

- Competition with Other Instream Water Uses. Inadequate instream flow can adversely alter the habitat of fish and other aquatic biota and reduce the aesthetic quality of the rivers. Instream uses of water for fisheries and environmental management have gained increasing legal status since the mid-1960s (Lamb and Doerksen, 1990).

- Water Rights Issues. Especially in many western states, where water law has traditionally been based on the Appropriation Doctrine, ownership of property fronting a river or lake does not necessarily convey the right to withdraw water from that body (Lamb and Doerksen, 1990; Gramm, 1993). Many states in both the East and the West require permits for the withdrawal of surface water.

3.7.2.3 Floodplains

Issues and concerns involving floodplain protection include the following:

- Economic Losses. Structures in a floodplain are subject to loss or damage during floods, and material dislodged by floodwaters can cause property damage downstream.

- Floodwater Displacement. Activities that result in filling part of a floodplain displace floodwaters, leading to increased floodwater height and intensity elsewhere in the floodplain. The displacement is most severe if the filling encroaches on the floodway.

- Ecological Value of Floodplains. Of the roughly 49 million hectares (121 million acres) of riparian lands in the United States, only about 9 million hectares (23 million acres) are in their natural or seminatural state (Stein, 1992). Many floodplains support unique plant communities comprising species that can withstand periodic inundation of their root systems and produce root systems that effectively buttress the plant against falling over in waterlogged soils (Clapham, 1983). Many wetlands associated with streams and rivers occur within the floodplain (Section 3.11).

- Water Quality Issues. The riparian vegetation growing at the edge of stream and river channels stabilizes banks and influences surface water quality. The ranges of many aquatic species endemic to cool, shaded headwaters have been reduced by the removal of riparian vegetation (Hynes, 1970). The storage or use of chemicals in a floodplain can contaminate downstream soils and surface waters during floods.

- Wild and Scenic River Issues. Approximately 17 percent of the total linear distance of river channels in the United States (and their adjoining floodplains) have been inundated by man-made impoundments. Additional river length has been straightened and dredged. As of January 1992, protection under the Federal Wild and Scenic Rivers Act had been extended to 125 river segments totaling 15,218 kilometers (9,452 miles) in 32 states (Stein, 1992).

3.7.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for surface water quality, surface water quantity, or floodplains would generally involve the affected downstream portion of the watershed. For activities at inland sites, the ROI would generally encompass specific reaches (segments) of rivers and streams and/or specific lakes or ponds. For activities at coastal sites, the ROI would generally encompass specific portions of estuaries and/or nearshore oceans. For activities involving launches over the open ocean, the ROI would encompass affected ocean waters as well. Determining the downstream extent of ROIs involving rivers or streams, or of the outward extent of ROIs in large lakes, estuaries, or the ocean would require knowing specific hydrologic characteristics of the affected water bodies and of the anticipated impacts.

3.7.4 RANGE OF CONDITIONS

3.7.4.1 Surface Water Quality

The quality of surface water across the ROA is diverse, affected by both natural processes and human activities. Regional generalizations are not especially useful in assessing water quality impacts, since the quality of water in bodies that are geographically close can vary widely in response to localized differences in natural conditions and pollution sources.

Water quality data can be obtained for many surface water bodies from data bases such as the Water Storage and Retrieval System, maintained by the U.S. EPA. For some surface water bodies, more complete water quality data are available from other Federal or state agencies. If available data are inadequate, water samples can be collected from the surface water bodies in the ROI and analyzed using methods approved by the U.S. EPA.

Water quality in 10 percent of those river and stream miles assessed in CONUS, Hawaii, and Puerto Rico in 1990 did not meet the designated standard. Another 21 percent of those rivers and streams only partially supported their designated use, and an additional 7 percent were adequately polluted to threaten the designated use. Water quality in 21 percent of assessed lake acres in 1990 did not support the designated use (U.S. EPA, 1992).

Approximately 76 percent of the river length in Hawaii supported its designated uses in 1990, and all of the estuarine area assessed in Hawaii was considered "fishable." Alaska did not submit comparable data on surface water quality in 1990 (U.S. EPA, 1992). There are no inland surface waters on USAKA. Marine water quality in the vicinity of USAKA is generally excellent except in specific locations in shallow waters adjacent to several USAKA islands where elevated levels of copper and mercury have been noted in marine organisms (USASSDC, 1993a).

3.7.4.2 Surface Water Quantity

As is the case with surface water quality, the quantity of surface water available for withdrawal (offstream use) can vary widely throughout the ROA, even for surface water bodies that are near each other. Regional generalizations are therefore not especially useful in assessing the impacts of surface water withdrawals.

The United States and its possessions have been divided into 21 water-resources regions for the purposes of recording hydrologic data. The boundaries of the water-resources regions generally coincide with the natural drainage areas of major rivers or groups of major rivers. The water-resources regions are further subdivided into 222 subregions, each generally corresponding to the drainage area of a river. Offstream consumptive use (plus net reservoir evaporation losses) as a percentage of renewable supply is highest in the Western and Great Plains states and lowest in the Eastern states, the Pacific Northwest, Alaska, Hawaii, and U.S. Caribbean possessions (Foxworthy and Moody, 1986). Surface water is not available on USAKA, where water requirements are met exclusively through the use of groundwater, rainwater catchments, and (following completion of its construction) a desalination plant (USASSDC, 1993a).

3.7.4.3 Floodplains

The Federal Emergency Management Agency has published maps delineating floodplains for many parts of the ROA. Flood Hazard Boundary Maps, which provide an approximate delineation of the 100-year floodplain and other special flood hazard areas, are the best available information for some areas. Flood Insurance Rate Maps (FIRMs) provide more precise delineations based on hydrologic and hydraulic calculations. FIRMs typically designate all land areas as either Zone A (the 100-year floodplain), Zone B (the 500-year floodplain), or Zone C (not subject to inundation by the 500-year flood). Some FIRMs differentiate Zone A into the floodway and the floodway fringe.

Floodplains in most inland locations would generally be associated with rivers and streams. Flood hazard areas in coastal locations would generally comprise areas subject to spring tides, storm surges, and tsunamis.

Beaches and barrier islands are especially vulnerable, although many other low-lying coastal areas are also subject to these hazards.

3.8 GROUNDWATER

3.8.1 DEFINITION OF TOPIC

Groundwater is defined as water that occurs in saturated nonconsolidated geologic material (sand or gravel) and in fractured and porous rock (Patrick, 1987). Saturated strata containing sufficient groundwater that the water can be pumped out are termed aquifers. Aquifers overlain by permeable materials through which precipitation can percolate downward and recharge the aquifer are termed unconfined aquifers. Aquifers separated from the surface or other aquifers by relatively impermeable geologic formations are termed confined aquifers. Confined aquifers in which the groundwater is under greater than atmospheric pressure are termed artesian aquifers. Some confined aquifers are subject to recharge by water entry at discrete recharge areas, while other confined aquifers have virtually no recharge areas (Patrick, 1987). Water withdrawn from the latter should be considered a nonrenewable resource.

3.8.1.1 Groundwater Quality

Contamination can render groundwater unsuitable for many uses. In many areas, groundwater is the only reliable source of potable water. Because groundwater is the only economical source of water in many locations, even localized contamination can create regional water shortages. Of particular concern are sole-source aquifers. Sole-source aquifers are the sole or principal drinking water source for an area and which, if contaminated, would constitute a hazard to public health. Groundwater has a low capacity for self-purification and may remain contaminated for years or decades. Many current drinking water problems have originated from incidences of contamination that occurred many years earlier (Stein, 1992; Ragone, 1988).

3.8.1.2 Groundwater Quantity

The hydrologic properties of an aquifer are related to the geologic properties of its component soils or rocks. Groundwater occupies voids such as the fractures and pores in rocks and the spaces between adjoining soil particles. The ratio of the volume of void space to the total volume of the aquifer is its porosity, a measure of the total groundwater quantity potentially in storage in the aquifer. Specific yield refers to that quantity of groundwater under the influence of gravity (and thus available to be pumped out of the aquifer for human use). The recharge rate is the rate at which groundwater naturally accumulates in the aquifer. The recharge rate represents the rate

at which groundwater may be pumped from the aquifer without resulting in a net reduction in the quantity of groundwater in storage.

Since about 1950, groundwater has become the preferred source of new water supply throughout much of the United States and is being used increasingly for most purposes (except thermoelectric power generation). Groundwater is the only, or dominant, source of drinking water for most rural areas. It is the largest source of water for irrigation. Except where it has been contaminated by human activities, groundwater is typically free of the suspended sediments and disease-causing organisms common in even surface water unaffected by human activities (CEQ, 1989).

3.8.2 ISSUES AND CONCERNS

3.8.2.1 Groundwater Quality

Contaminated groundwater has been identified in every state in the United States. As of 1984, at least 8,000 water wells throughout the United States had been rendered unusable or yielded degraded water as a result of groundwater contamination (U.S. EPA, 1988).

Issues and concerns pertaining to groundwater quality include the following:

- Demand for Clean Drinking Water. Groundwater is the only readily available source of drinking water in many areas not served by municipal water systems. Half of all Americans, and 95 percent of all rural Americans, use groundwater for drinking water, and groundwater is also a key source of water for agriculture and industry (U.S. EPA, 1988). The public generally expects uncontaminated groundwater to be available for drinking water at any location (Mlay, 1988).

- Sources of Groundwater Contamination. Sources of groundwater contamination include waste disposal injection wells, discharges from septic tanks and cesspools, leakage from sewers and landfills, runoff from fields treated with agricultural chemicals, and leakage from underground storage tanks (CEQ, 1989; U.S. EPA, 1988). Of particular concern is the occurrence of these sources of contamination within major aquifer-recharge areas or areas near water-supply wells (David, 1988).

- Hydrologic Connection to Surface Water. Contaminated groundwater can enter and contaminate surface water by way of springs, wetlands, and other hydrologic connections.

- Hydrologic Connection to Groundwater. Contaminated surface water can reduce groundwater quality under certain circumstances.

- Influence of Groundwater Overdraft. Excessive groundwater withdrawal rates can influence the migration of previously contaminated groundwater. Excessive withdrawal can also result in the intrusion of saline groundwater into freshwater aquifers, especially in coastal areas.

- Difficulty of Groundwater Cleanup. Groundwater is easily contaminated and very difficult to clean up, and the ability to completely clean up groundwater contamination is uncertain (Johnston, 1988).

3.8.2.2 Groundwater Quantity

Of the 1,283 billion liters per day (BLD) (339 billion gallons per day [BGD]) of freshwater withdrawn from all sources in the United States in 1990, 301 BLD (79.4 BGD) were withdrawn from groundwater (Solley, 1992). Issues and concerns related to excessive withdrawals of groundwater include the following:

- Reduced Future Availability. Withdrawal of groundwater from aquifers at rates exceeding the rate of recharge (groundwater overdraft) can reduce the future availability of water from those aquifers. It is estimated that approximately one-fifth of all groundwater pumped in the United States is essentially nonrenewable because it is removed from aquifers that have very slow recharge rates (Stein, 1992).

- Land Subsidence. Overdraft of groundwater from aquifers can result in land subsidence, an irreversible settling of the unconsolidated sands and gravels that comprise many aquifers. Such collapsed aquifers can never be fully recharged (Stein, 1992). Groundwater withdrawal can also lead to the formation of sinkholes in karst terrance, as has occurred in Florida (CEQ, 1989).

- Saltwater Intrusion. Overdraft of fresh groundwater from certain aquifers in coastal areas can result in the intrusion of saltwater into the aquifer. Overdraft in other areas can result in the intrusion of water higher in dissolved solids from greater depths (CEQ, 1989). This has occurred in Florida and the Atlantic Coastal Plain.

- Reduced Stream Flow. Overdraft of groundwater can result in the reduction or elimination of flow in streams (Patrick, 1987). Flow in many headwater streams is derived principally from groundwater discharge at springs or seeps.

- Absence of Water Rights. Especially in many western states, groundwater underlying a tract of land may not be available for withdrawal, because title to the land does not necessarily include the legal right to use underlying groundwater. The rights

to such water could require purchase from the present holder, who may be unwilling to sell.

3.8.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for groundwater quality and groundwater quantity would encompass all or portions of each aquifer underlying areas of each BMD activity. Although many aquifers are not isolated hydraulic systems, contaminants generally move slowly in groundwater. Therefore, the ROI could be limited to localized portions of aquifers rather than encompassing entire large aquifers underlying multiple counties or states.

3.8.4 RANGE OF CONDITIONS

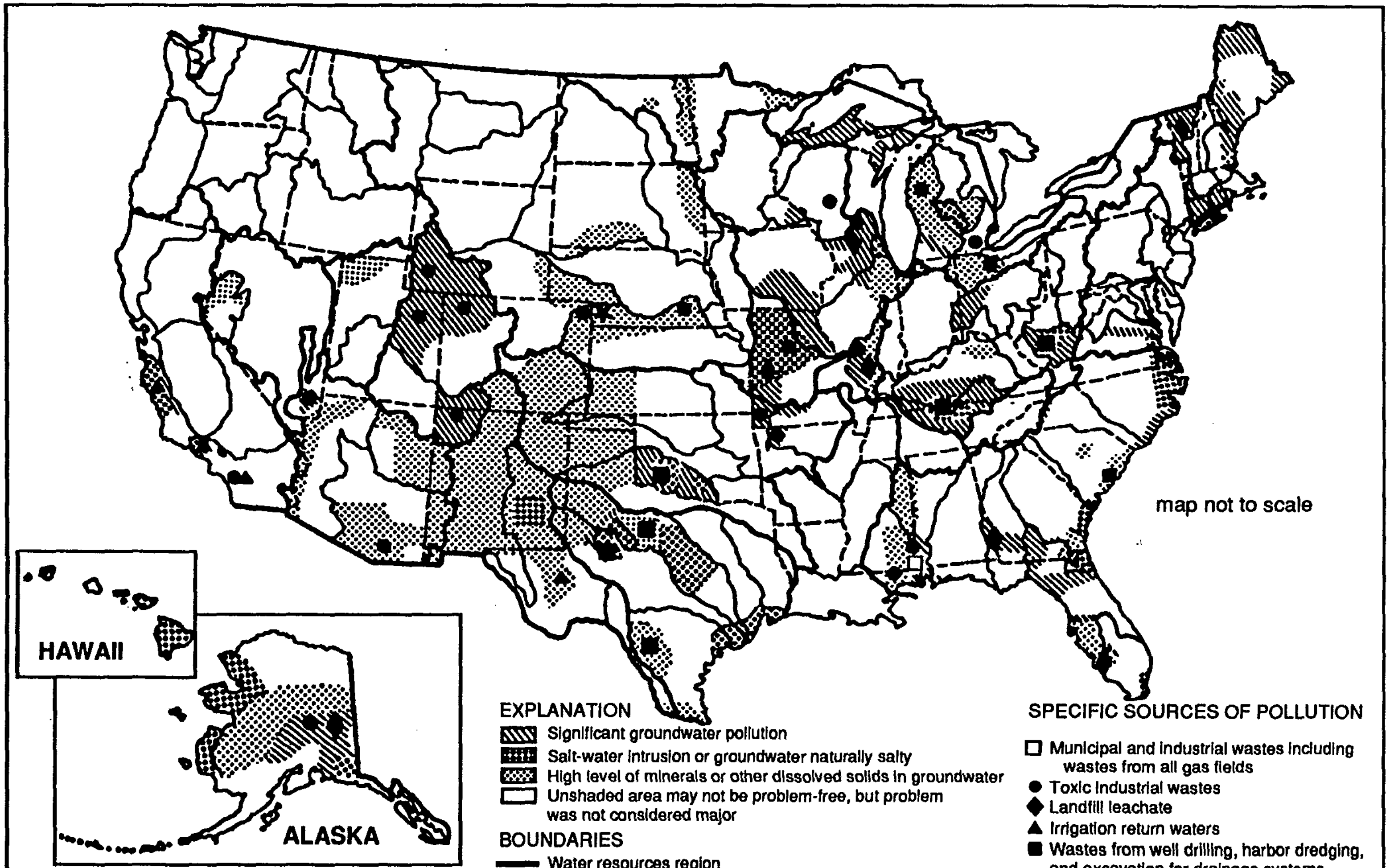
Separate discussions for groundwater quality and quantity are provided.

3.8.4.1 Groundwater Quality

The quality of groundwater across the ROA is diverse, affected by both natural processes and human activities. The natural quality of unpolluted groundwater is determined largely by the characteristics of the materials through which the water flows (Johnston, 1988). Contamination is generally the result of human activities in recharge areas. Aquifer-specific groundwater quality data can be obtained for some aquifers from the U.S. Geological Survey or other federal or state agencies. Otherwise, the potentially affected aquifers could be sampled using methods approved by the U.S. EPA.

State Water Quality Reports submitted to the U.S. EPA indicate that the overall quality of groundwater in the United States in 1990 was good (U.S. EPA, 1992). However, all parts of the United States include localized areas that are experiencing groundwater pollution. A generalized map outlining areas of the CONUS, Alaska, and Hawaii experiencing groundwater quality degradation is provided in Figure 3-10. In general, the shallow, permeable, unconfined aquifers with high recharge rates that are characteristic of the eastern CONUS are more susceptible to contamination than the deep, confined aquifers characteristic of the western CONUS (Johnston, 1988).

Shallow aquifers of fresh and brackish groundwater underlie the atolls of USAKA. Although the sustainable yield of these aquifers is low, they are a key source of potable water for facilities where freshwater is scarce. The salinity of water in these aquifers is sensitive to both natural tidal fluctuations and the rate of freshwater withdrawal (USASSDC, 1993a).



Source: Modified from Patrick, 1987.

Figure 3-10. Groundwater Pollution Problems in the United States

3.8.4.2 Groundwater Quantity

The availability of groundwater varies widely over the ROA, and is a function of both the hydraulic characteristics of the aquifers and the rate that groundwater is being withdrawn by other local users. The availability of groundwater at specific sites is also influenced by localized differences in hydraulic characteristics and in the rate that existing wells in the same locality are withdrawing groundwater.

Several areas of the United States (the Southwest, especially southern California, southern Arizona, and the southern Great Plains from Texas to Kansas) are experiencing critical overdrafts of groundwater (over 1.9 BLD [0.5 BGD]) and have low surface water availability relative to demand. In many other areas of the country (the Northwest, the Great Basin, and the Southeast), there are moderate overdrafts (0.08 to 1.9 BLD or 0.02 to 0.5 BGD) (BMDO, 1993). Due to groundwater overdraft, the depth to water in the Ogallala aquifer, which underlies much of the western plains, has dropped by more than 15 meters (50 feet) in several locations. Figure 3-11 shows areas of the CONUS, Alaska, and Hawaii experiencing problems related to overdraft of groundwater, including aquifer subsidence, diminished stream flow, and saltwater intrusion.

The sustainable yield of groundwater from the thin, shallow aquifers underlying atolls and other small oceanic islands is limited. For example, the estimated sustainable yield of freshwater from the aquifer underlying Kwajalein Island, the largest of the atolls, is estimated to be only 189 million liters (50 million gallons) per year (USASSDC, 1993a).

3.9 VISUAL RESOURCES

3.9.1 DEFINITION OF TOPIC

Visual resources are the definable appearance of a landscape unit as described by elements such as landform, vegetation, water, and man-made features. They are those man-made or natural features which can be seen. The elements which make up a landscape unit are described in terms of their visual quality within a physiographic region. The value and importance of these elements are described relative to the region rather than with a dissimilar landscape.

Visual resource quality is influenced by the relative size of an object, particularly its height, the dissimilarity to its surroundings, including shape and color, and the quantity and frequency of viewers. Although visual quality is subjective, it can be termed high, average, or low based on the region. For example, a barn in a rural, agricultural setting may characterize the region and may be a distinctive or dominant feature of the area. This barn could be rated high in visual quality. If the same barn were located in a

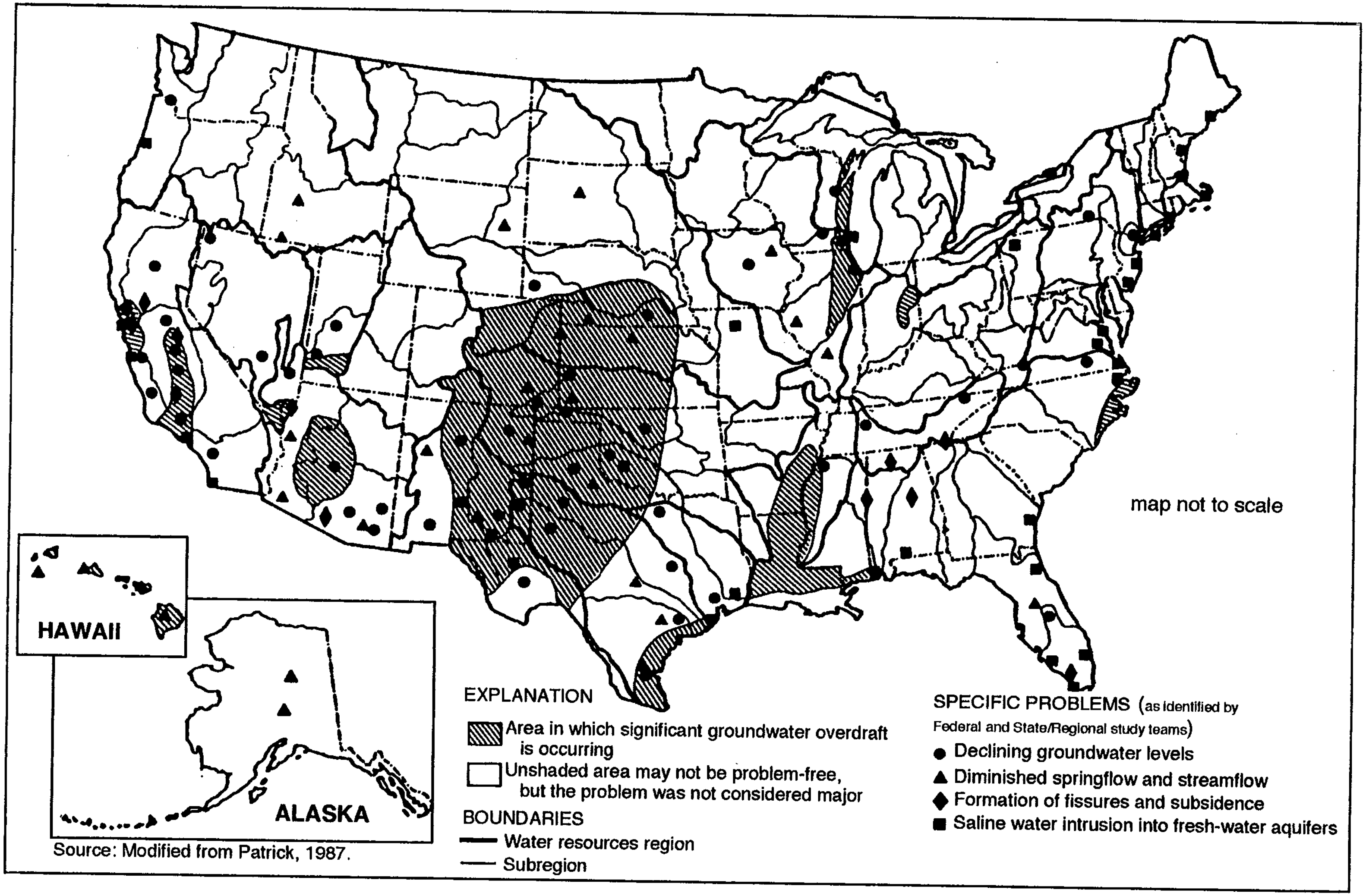


Figure 3-11. Groundwater Overdraft and Related Problems in the United States

valley together with a number of identical barns, it could be considered of average visual quality since it would be characteristic of the area but not distinctive.

In addition to visual quality, the dominance of an element is important. Dominance is characterized by form, line, color, and texture. Form is the mass or shape of an object or of objects which appear unified. Line is the path, real or imagined, that the eye follows when perceiving abrupt differences in form, color, or texture. Color enables the viewer to distinguish objects even though they are identical in form, line, and texture. Texture is the aggregation of small forms or color mixtures into a continuous pattern.

How dominance is viewed is determined by factors such as motion, light, atmospheric conditions, seasons, distance, observer position, scale, and time. For example, a mountain which has the sun behind (backlighting) will have obscure details but the top and edges will be highlighted. When the sun is in front of the mountain (frontlighting), the mountain will appear flat and one-dimensional. As the sun moves to the side (sidelighting), the mountain appears three-dimensional and shadow is created, giving the mountain line, form, color, and texture (USFS, 1973; BLM, 1986a).

Finally, it is important to consider the type of users, the amount of use, public interest, and viewer expectations. These factors determine the sensitivity of a landscape to change (BLM, 1986b; USFS, 1973). Once the visual resource has been defined in terms of quality, dominance, and sensitivity, potential impacts to the resource can be assessed.

3.9.2 ISSUES AND CONCERNS

Visual quality is of major concern to the public. Specific concerns include changes to the environment which may diminish or destroy the quality of visual resources. Introducing man-made structures, such as buildings, into a previously rural or undisturbed environment may intrude upon the visual quality of an area. Conversely, the demolition of structures can be detrimental to the visual quality of an area if the structures define or enhance the area. Also, removal of mature forest cover or established landscaping can reduce the visual quality of the surrounding landscape. Air pollution may be of concern if it reduces visibility in an area.

3.9.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

Defining the ROI for visual resources would include taking an inventory of the resources surrounding the site of each BMD activity, evaluating land use in and around the site, and evaluating the appearance of the site as seen from surrounding areas. Potential visual resources at a site may include regional, local, and on-site landscapes. Visibility can be evaluated by

viewing sites from different directions. The number and frequency of people viewing or visiting a site affect potential visibility ratings. An area that is visited daily by large numbers of people can receive a high-visibility rating. An area that is visited by small numbers of people (such as a wilderness area) can receive a low-visibility rating. However, a low-visibility rating does not make an area less visually pleasing or of less visual quality.

Evaluation of the site and region must be based on professional methodologies and incorporate outside data such as scenic views, historic landmarks, protected lands such as national parks and forests, and land use. For example, urbanized settings have many more man-made features, experience more intense land use, and are more visible to large numbers of people than are rural settings. Therefore, the addition of a new building is less likely to change the aesthetic quality of an urban area than is the addition of a new building in a rural area. Similarly, a new building in a historic district of an urban area can look out of place, whereas that same building in a suburban office park can blend into its surroundings.

Guidelines for assessing visual quality have been prepared by a number of government agencies, including the Bureau of Land Management Visual Resource Management Program (BLM, 1986a, 1986b) and the Forest Service Visual Management System (USFS, 1973). In addition, the Soil Conservation Service (1978) and the U.S. Army Corps of Engineers (Smardon, 1988) have published guidelines for assessing visual resources. These methods were designed for different purposes. The BLM manual would be applicable to rangeland sites, while the U.S. Forest Service method would be applicable to forested sites. These documents also outline management methods for visual resources.

3.9.4 RANGE OF CONDITIONS

The ROA includes a variety of landscapes including urban, suburban, rural, and undeveloped/natural areas. In addition, regional differences in viewer expectations, visibility, and user activities contribute to the range of conditions for visual resources.

- Urban areas are more developed than other areas, and viewers expect to see buildings, construction, and demolition. Additionally, urban and industrial areas have potential for less visibility due to air pollutants. These areas are the least affected by the addition of buildings. Urban areas can be found in every state and region in the United States and on some of the Pacific Island territories.

- Suburban areas are generally residential and have less commercial or industrial activity than urban areas.

- Rural areas are less populated than urban or suburban areas. Although these areas are seen by fewer persons than are urban or suburban areas, construction and demolition activities are generally more noticeable because they do not occur on a frequent basis. In addition, industrial structures are generally not expected to be present.

- Undeveloped/natural areas are generally protected (such as large national or state parks or wilderness areas) or remote areas. Except for certain parks with tourist use, these areas generally have low populations and few visitors. There are greater expectations associated with these areas, since viewers who do visit or inhabit them typically do so because of the pristine qualities.

Other conditions can affect an area's visual quality, including distinct geologic features of the landscape (topography), distinct vegetation (habitat and vegetative cover), climate, variety in the landscape, and the presence or absence of water resources. Distinct topography is often associated with volcanically active areas or settings such as coastal, mountainous, and desert environments. Distinct vegetation is associated with topography and climate. A desert has vegetation habitat types different from those in a more mountainous climate. Variety is important because as landscape varies, it appears more interesting. The presence or absence of water is important because water represents a visual distinction that enhances the quality of a landscape.

A combination of the above conditions describes each geographic area and can be used to identify broad regions based on visual resources (e.g., northeastern, southeastern, and midwestern United States). Each region has its own identity and aesthetic qualities. Expectations within each region are based on all of the conditions. Therefore, the potential degradation of visual and aesthetic quality by any activity would depend on the character of the proposed activity, its visibility, and viewer expectations for the surrounding area.

3.10 CULTURAL RESOURCES AND NATIVE POPULATIONS

3.10.1 DEFINITION OF TOPIC

The heritage of the United States is reflected in the sites, structures, districts, and objects which contribute to the understanding of American history and culture. This heritage includes prehistoric and historic resources and the resources of Native populations. For the purposes of this analysis, paleontological resources are also discussed in this section.

- Paleontological resources include the physical remains or impressions of life forms from earlier geological ages, such as

fossils, that contribute scientific knowledge on the history of plants and animals. These typically occur in such contexts or localities as surface exposures, subsurface deposits exposed by ground-disturbing activities, and sites affording special environments for preservation (such as caves, peat bogs, and tar pits).

- Prehistoric resources include geographic areas, sites, structures, objects, and other evidence of past human activity considered important to a culture, subculture, or community for scientific or humanistic reasons. These resources predate the introduction of written records within a particular geographic region and may exist in subsurface and surface contexts.

- Historic resources include districts, sites, structures, objects, documents, and other evidence of past human activity considered important to a culture, subculture, or community for scientific or humanistic reasons. Historic resources postdate the advent of written records in a particular geographic region.

- The cultural resources of Native peoples include geographic areas, sites, burial grounds, structures, objects, biota, and other natural features which have historic, cultural, and religious importance to Native Americans, including Native Alaskans and Hawaiians, and the Native peoples of the Marshall Islands.

The National Historic Preservation Act (NHPA) of 1966, as amended (16 USC 470), is the key federal regulation for the identification and preservation of cultural resources. The NHPA established the National Register of Historic Places (NRHP), an ongoing inventory of important cultural resources. The NRHP contains more than 60,000 entries located as follows: approximately 22,800 in the northeastern United States; 17,400 in the southeastern United States; 9,300 in the midwestern United States; 9,900 in the western United States; 300 in Alaska; and 260 in Hawaii. In addition to those properties presently listed on the NRHP, federal regulations protect other cultural resources which are eligible for listing on the NRHP.

3.10.2 ISSUES AND CONCERNS

Issues and concerns regarding impacts to cultural resources are focused on the damage or destruction of properties eligible for listing on the NRHP or significant to the cultures of Native American people. Damage to cultural resources can be direct, such as ground disturbances resulting from construction of new facilities or off-road vehicle use, or indirect, such as visual, auditory, and atmospheric disturbances. Also, alterations or additions to historic structures can reduce their architectural integrity.

Impacts to Native American traditional religious practices may result from activities which cause visual or auditory disturbances or which restrict or

deny access to Native American sacred sites of worship. Ground-disturbing activities, such as construction and demolition, could intrude upon burial grounds and disturb the human remains and associated sacred objects and areas of Native American peoples.

3.10.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

The ROI for cultural resources would encompass the construction footprint and the additional area disturbed during construction activities for each BMD activity, any surrounding areas in which access could be restricted for safety or security, and any surrounding areas that could experience visual, auditory, or atmospheric changes attributable to the activity. As noted in Section 3.10.2, visual, auditory and atmospheric activity could impact cultural resources for substantial distances from the construction footprint.

3.10.4 RANGE OF CONDITIONS

The earliest human settlement in the area that is now the United States is dated at 12,000 - 10,000 B.C. By 9,000 B.C., scattered hunter-gatherer populations lived throughout North America (Fagan, 1991). These prehistoric peoples practiced a variety of social, cultural, and subsistence patterns as influenced by their environment.

Although prehistoric populations are known to have inhabited all parts of the United States, the extensive historical development east of the Mississippi River has caused great disturbance to areas which could have once yielded prehistoric archaeological material. The more sparsely populated, less developed areas of the western and southwestern regions have a greater potential for prehistoric sites that retain their integrity.

Prehistoric sites can include villages, campsites, quarries, hunting camps, and rock shelters. Areas where prehistoric sites occur can be predicted based on analysis of settlement patterns and methods of subsistence. Because shelter from the elements and access to reliable sources of water are primary determinants of prehistoric settlement patterns, water resources and geographic relief forms are potential indicators of prehistoric archaeological sites. Sites may occur where natural food resources could be readily obtained on a seasonal or year-round basis, such as river valleys.

Europeans began settling in North America in the 16th century A.D. Their arrival, along with the introduction of written records within a particular region, marks the general distinction between the prehistoric and historic periods. Spanish colonists established mission settlements in the Southwest in the 17th century. Population growth and increasingly scarce supplies of land and other resources led to migrations into the central regions.

Historical resources are found throughout the ROA in both urban and rural settings and include:

- Buildings, such as houses, and public and commercial facilities
- Sites, such as battlefields
- Structures, such as bridges
- Objects, such as fountains or monuments

With the exception of Spanish mission settlements in the Southwest, the oldest historical resources in the United States are generally located in the towns and cities of the eastern seaboard. In general, historical resources are generally less concentrated in the western regions of the country. Military bases may possess historic importance if they are associated with important events or persons in military history (ACHP, 1991).

Federal facilities may contain scientific and technical resources with historic value. Such resources include sites publicly associated with certain scientific advances or technologically important events, such as the Missions Operations Control Center at Johnson Space Center near Houston, Texas; equipment and facilities used to make advances in science and technology, such as the Saturn V Dynamic Test Stand at Marshall Space Flight Center in Huntsville, Alabama; rare or unique examples of historically important technology such as the Hale 200-Inch Telescope at Palomar Observatory in San Diego, California; and architecturally important laboratory buildings and facilities such as the U.S. Naval Observatory.

The cultural resources of Native peoples overlap those described for prehistoric and historic resources. Native Americans are known to have inhabited all areas of the country into modern times.

Some present-day Native American peoples and tribes retain cultural affiliation with sacred sites and the buried human remains and associated objects of their ancestors. These sites may include ancestral sites in distant locations. Identification of the cultural resources of Native Americans must be done in consultation with present-day representatives of Native American tribes. There are 515 federally recognized Native American tribes located throughout the United States as follows: northeastern United States/Great Lakes, 32; southeastern United States, 8; Great Plains, 74; southwestern United States, 43; Great Basin (Nevada, Utah, Colorado), 26; northwestern United States, 37; California, 98; and Alaska, 197 (BIA, 1988).

Paleontological materials occur in many formations across the United States and its territories and the Marshall Islands. These resources include the preserved remains of environmental events that offer insights into past climatic and biological conditions, such as buried lake beds, river and stream terrace soils, and fossils.

Sites that have already been listed on the NRHP could be identified by contacting the State Historic Preservation Office (SHPO). Consultation with additional experts, and records searches and field surveys could be performed to characterize other cultural resources in some ROIs.

3.11 BIOLOGICAL RESOURCES AND WETLANDS

3.11.1 DEFINITION OF TOPIC

Biological resources are defined for the purposes of this PEIS as the native and naturalized flora and fauna in terrestrial and aquatic ecosystems. Threatened and endangered species, migratory birds, eagles, marine mammals, and wetlands are of special importance because they are specifically subject to protection under federal and state laws.

Endangered species are defined under the Endangered Species Act (ESA) (16 USC 1531 et seq.) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service (U.S. FWS) may designate areas of critical habitat for threatened and endangered species. Critical habitat is defined as specific areas containing physical and biological features essential to the conservation of species and which may require special management considerations or protection. Species which are proposed or are candidates for listing as threatened or endangered are not protected legally; however, their status can be changed to threatened or endangered in the foreseeable future. Species formally proposed as threatened or endangered must be given consideration in biological assessments. Candidate species include Category 1 (appropriate for protection) and Category 2 (possibly appropriate for protection). At the state level, protected species are classified into a variety of categories, including endangered, threatened, rare and sensitive, protected, in need of management, of concern, in need of monitoring, or species of special concern. Marine mammals such as whales, dolphins, seals, and sea lions are protected under the Marine Mammal Protection Act (16 USC 1361 et seq.). Bald and Golden eagles are protected under the Bald and Golden Eagle Protection Act (16 USC 668 et seq.).

Migratory birds are those making regular seasonal movements between overwintering and breeding areas. A list of specific migratory bird species protected under the Migratory Bird Treaty Act (16 USC 703 et seq.) has been developed and published in the *Federal Register* (50 CFR 10).

Wetlands are defined by the U.S. Army Corps of Engineers and the U.S. EPA as "...those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include

swamps, marshes, bogs, and similar areas" (33 CFR 328.3 and 40 CFR 230.41, respectively). Wetlands are delineated based upon the occurrence of characteristic vegetation, soils, and hydrology (Environmental Laboratory, 1987).

3.11.2 ISSUES AND CONCERNS

Direct and indirect impacts to biological resources could result from BMD activities. Discharge of dredged or fill material in waters of the United States, including wetlands, is regulated under Section 404 of the CWA and requires a permit from the U.S. Army Corps of Engineers. Permits and other regulatory requirements designed to protect threatened and endangered species and wetlands could affect project site planning. Impacts to threatened and endangered species are regulated under the ESA and, in most states, under comparable state-level legislation. The Migratory Bird Treaty Act could affect construction and operation activities if the activities destroy nests or eggs of migratory birds or threaten the birds themselves.

3.11.2.1 Natural Habitats

Issues and concerns pertaining to terrestrial and aquatic natural habitats include the following:

- Loss or Degradation of Habitat. Loss or degradation (e.g., forest fragmentation, sedimentation, or increased human disturbance) of terrestrial or aquatic habitat can affect adversely the flora and fauna that depend on those habitats for their existence. Habitat destruction can result in loss of nesting areas, spawning or breeding areas, and feeding areas, and lead to alterations in migratory routes. Localized loss or degradation can lead to the displacement of larger and more mobile fauna to adjoining habitats, resulting in populations that exceed the carrying capacity of those habitats. Localized impacts could also include electrocution of raptors on new powerlines.

- Destruction of Slow-Moving or Immobile Species. Plants and many slow-moving or immobile animal species can be killed by human activities in terrestrial or aquatic habitats. Nests containing eggs or juveniles are especially vulnerable.

- Noise and Pollution. Flora and fauna can be disturbed by noise (e.g., nest abandonment or changes in mating behavior) (Section 3.5); and air and surface water pollution (Sections 3.1 and 3.7, respectively).

- Vegetation Disturbance. Vegetation disturbance can result in increased soil erosion (Sections 3.7 and 3.14) and reduced visual quality (Section 3.9). Many types of vegetation such as old-growth forests, previously undisturbed (climax) grassland,

and desert vegetation cannot be restored except over a very long period (usually centuries).

- Regional Reduction in Biodiversity. On a regional basis, population reductions or extirpation of certain plants and animals could reduce the variety and variability of biota, consequently reducing biodiversity and the full functioning of the ecosystem.

3.11.2.2 Threatened and Endangered Species

Reduction in the populations of threatened or endangered species or destruction of critical habitat could contribute to their eventual extirpation from localized regions or their ultimate extinction, reducing regional and global biodiversity. Some species facing extinction could be of undiscovered economic importance, or importance to the ecosystem in which they exist. For example, some rare plants could be of medicinal or agronomic value.

3.11.2.3 Migratory Birds

Destruction of necessary foraging grounds along migratory routes could ultimately prevent migrating birds from reaching their breeding grounds or wintering destinations. Land-clearing activities during the nesting seasons of migratory bird species could disrupt nesting activities or destroy nests and nestlings. Fragmentation of large tracts of forest could result in increased predation and the intrusion of bird species (e.g., the cowbird) which might impair the survival of species present in the interior forest. Noise associated with rocket launches could disturb migratory birds in the launch area.

3.11.2.4 Wetlands

Loss of wetlands can result in adverse impacts to surface and groundwater quality and quantity, increased shoreline erosion, increased flooding, decreased habitat quality for fish and other aquatic biota, and loss of specialized habitat required by threatened and endangered species, as well as more numerous waterfowl, mammal, songbird, amphibian, and reptile species. Like other surface waters, wetlands are subject to the same types of water quality and water quantity issues and concerns discussed for surface water in Section 3.7.2.

3.11.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for biological resources would encompass all terrestrial and aquatic resources potentially affected by BMD activity. In addition to actual construction footprints, activities can result in impacts to resources in surrounding areas. The outward extent of the ROI would be closely related

to the ROI boundaries used for air quality (Section 3.1), EMR (Section 3.3), noise (Section 3.5), and surface water (Section 3.7).

3.11.4 RANGE OF CONDITIONS

The ROA encompasses a wide variety of biological conditions. Biological resources are unique to any given site. For purposes of this PEIS, natural biotic resources are grouped into broad geographic categories to identify the range of types that could be affected by specific activities.

3.11.4.1 Natural Habitats

The following discussion characterizes the biomes occurring throughout the ROA. A biome is a community of living organisms within a major ecological region which is named typically after the characteristic climax vegetation (vegetation that develops following an extended time without major disturbance). Biomes are a useful method of describing terrestrial resources since they comprise similar groupings of flora and fauna. Although biomes are primarily a terrestrial resource classification system, the discussion of each biome addresses aquatic resources in the same geographical area as well. Two of the units discussed, mountain complexes and coastal and marine habitats, are technically not biomes but are included to provide complete geographical coverage of the ROA.

Biomes occurring in the ROA are shown on Figure 3-12. Although biomes are characterized by their climax vegetation, most areas across the ROA have been subjected to substantial human disturbance over the past centuries. These areas now largely support successional vegetation, which can include grasses and forbs, shrubs and saplings, or forest cover comprising species other than those of the climax vegetation. Each biome displays its own characteristic patterns of succession. Additionally, the boundary between a biome often consists of a blend of characteristics from both biomes.

Broad-leaved Evergreen Subtropical Forest

This biome, which occurs in south Florida and the Gulf Coast, features high rainfall combined with relatively minor seasonal changes in temperature. Vegetation in this biome is generally dominated by herbaceous freshwater marsh species rather than trees due to seasonal fluctuations in water levels. Variable water table fluctuations restrict the establishment of forest by successional processes.

Some typical native animals include white-tailed deer, black bear, raccoon, bobcat, eastern yellow bat, marsh rabbit, swamp rabbit, great blue heron, snowy egret, and mottled duck. Aquatic organisms include numerous

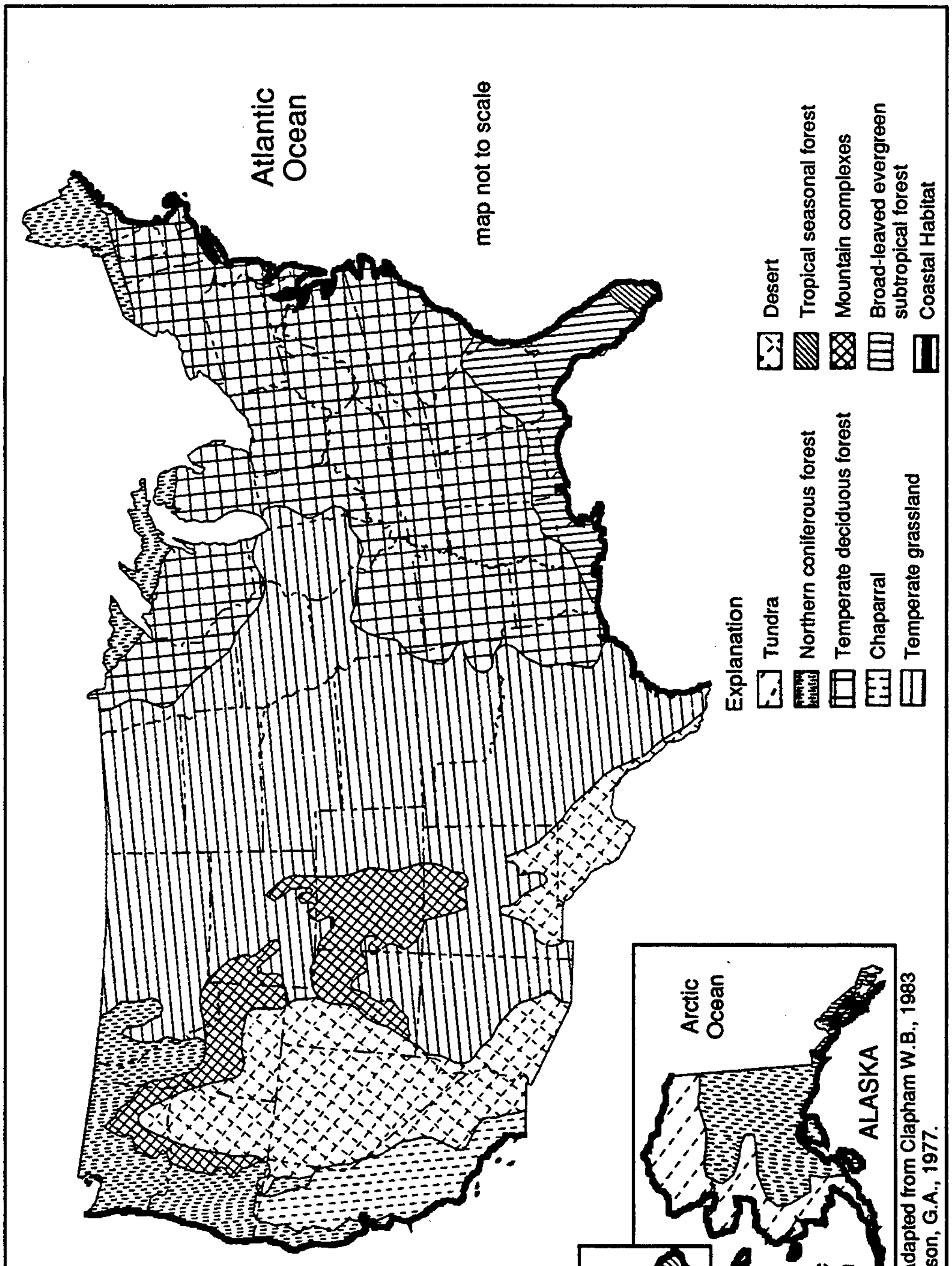


Figure 3-12. Biomes of the United States

species of fish, bivalves, crustaceans, and other biota adapted to living in fluctuating surface waters (Clapham, 1983; Odum, 1971).

Temperate Deciduous Forest

This biome occurs in most of the eastern third of the United States and is characterized by a moist, temperate, seasonal climate. The canopy of a temperate deciduous forest biome is dominated by 2 or 3 species of deciduous trees. A patchy to well-developed understory tree layer is found and shrubs are common.

The deciduous forest supports a variety of animal life including the white-footed mouse, eastern chipmunk, eastern gray squirrel, raccoon, opossum, striped skunk, bobcat, gray fox, white-tailed deer, black bear, wood thrush, ovenbird, downy woodpecker, and worm-eating warbler. Aquatic ecosystems and resources are abundant in the temperate deciduous forest biome and include rivers, streams, and coastal estuaries (Odum, 1971; Smith, 1980).

Temperate Grassland

This biome occurs in much of the midwestern United States and is characterized by pronounced seasonality with respect to rainfall and to temperature. Climax vegetation is characterized by grasses and other herbaceous plants because there is insufficient rainfall to support forest communities. Because of the naturally fertile, nearly level soil, much of this biome has been converted to farmland for producing grains and providing pasture for cattle. The grassland communities support upland game birds, white-tailed deer, and small furbearers. Playa lakes to the south and prairie pot holes to the north are important habitats for waterfowl and a number of other species of wildlife. Perennial and intermittent streams and small lakes characterize the aquatic resources of the grassland biome (Clapham, 1983; Smith, 1980).

Chaparral

This biome occurs along the Pacific coast in California and Oregon, where the climate is typified by mild winters with abundant rainfall and dry summers. The climax vegetation typically consists of dense or sparse shrub cover and low trees. Much of the chaparral is affected by the frequent occurrence of fires during the hot, dry summers, which favors plants that regenerate quickly. Vegetation is a mixture of deciduous, semi-deciduous, and evergreen species.

Terrestrial fauna is diverse, represented by species such as the California ground squirrel, wood rat, black-tailed jackrabbit, mountain lion, coyote, and mule deer. Birds include brown towhees, wren-tits, northern flicker, wild

turkey, California quail, and the endangered California condor. Freshwater aquatic resources are associated with a relatively few perennial streams and intermittent streams and washes that drain the chaparral during the winter and spring (Garrison, 1977; McNaughton, 1979).

Desert

This biome occurs in much of the southwestern CONUS and is characterized by scarcity of rainfall (less than 10 inches) or rainfall which is very unevenly distributed. Vegetation is sparse and consists mainly of shrubs and rapidly growing annuals. During the short periods of rainfall, a large number of grasses and forbs briefly appear. Although the environment is harsh, the desert supports a variety of fauna including the desert bighorn sheep, mule deer, jackrabbit, mountain lion, coyote, javelina, golden eagle, Greater roadrunner, Gambel's quail, desert tortoise, and various species of lizards, snakes, and scorpions. Aquatic resources are generally limited to intermittent streams and washes. Riparian areas, which are an important resource wherever they occur, are scarce in this biome (Odum, 1971; McNaughton, 1979).

Northern Coniferous Forest

This biome occurs in the extreme northeastern and northwestern regions of the CONUS and much of Alaska. The identifying vegetation consists of needle-leaved evergreen trees, especially spruce, fir, and pine. The trees form a dense canopy that results in poor development of shrubs and herbs. This biome supports a diversity of animals including red squirrel, snowshoe hare, ruffed grouse, pine siskin, and red crossbill. An abundance of streams, rivers, lakes, and coastal waters contain freshwater and saltwater aquatic species (Clapham, 1983).

Tundra

This biome occurs in Alaska. It is a very cold, virtually treeless biome characterized by permanently frozen soil called permafrost. The tundra is essentially a wet arctic grassland with vegetation consisting of lichens, grasses, sedges, and dwarf woody plants. Tundra fauna is characterized by brown lemming, arctic hare, arctic fox, barren ground caribou, musk ox, and willow ptarmigan. During the short summers, large numbers of migrating birds and biting insects also inhabit the tundra. The Alaskan tundra region includes a variety of freshwater aquatic habitats. The low-lying regions of the tundra also support extensive areas of bog-type wetlands (Clapham, 1983).

Tropical Seasonal Forest

This biome occurs in Hawaii and on many other Pacific Islands and is characterized by a very high rainfall segregated into pronounced wet and dry periods. Tropical forest vegetation, especially the canopy stratum, is very diverse. An acre can contain between 20 and 50 different species of trees (Clapham, 1983). Trees are also tall (25 to 39 meters, 82 to 128 feet) and usually have buttressed trunks. Shrub and herb layers tend to be thick only where sunlight enters as a result of breaks in the canopy vegetation. Vegetation from island to island can be quite variable, especially where the elevation changes in mountainous terrain, which creates a wide range of microclimates and vegetation zones.

Fauna within tropical seasonal forests are also quite variable. Numerous animal species are known to live on single islands. In many cases, animal species such as feral pigs and goats have been introduced by humans to an island ecosystem, resulting in destruction and extirpation of native plants and animals. Many birds and mammals are adapted to living in the trees of the canopy layer. Aquatic resources include both fresh-water and salt-water systems. Fragile coral reef aquatic systems that typically support a diverse array of biota are common close to the shores of islands in this biome (Clapham, 1983; McNaughton, 1979).

Other Habitats

Two other types of habitat include mountain complexes and coastal and marine habitats. Mountain complexes occur in the Rocky Mountains and in steep mountainous areas on many Pacific Islands, including Hawaii. They occur in areas of high relief and feature a large diversity of plant communities reflecting rapid altitude changes over short distances. A single mountainous area can feature four or five biomes within an elevational change of a thousand or so meters (several thousand feet). The flora and fauna of each of these biomes are often similar to those previously described (such as desert, grassland, temperate deciduous forest, northern coniferous forest, and tundra). However, due to isolation of the biomes, unique flora and fauna often occur (Clapham, 1983; Odum, 1971). Diverse freshwater aquatic species are associated with this biome.

Coastal habitat consists of estuaries, shorelands and nearshore ocean areas. Marine habitat consists of nearshore and offshore ocean and sea areas. Both types of habitats can be characterized by productivity. Productivity is the net output of the producers and consumers (flora and fauna) of an ecosystem and determines the amount of living matter in the ecosystem. Productivity of aquatic systems in coastal areas is highest along the Pacific coast, southern Alaska, and the northeastern Atlantic coast. Aquatic productivity decreases proceeding south along the Atlantic coast and north along the coast of Alaska. Although the coral reefs immediately surrounding

the Pacific Islands are among the most productive marine ecosystems, aquatic productivity rapidly declines in the open ocean (Clapham, 1983). Many parts of the ROA contain coastal and marine (ocean) habitats, although they are not technically a biome.

3.11.4.2 Threatened and Endangered Species

Threatened and endangered species may be present in each of the biomes discussed above, including mountain complexes, coastal and marine habitats and wetlands. Endangered plants and animals occur in all 50 states and U.S. territories (BMDO, 1993). Endangered plants and animals often rely on sensitive environments such as wetlands for habitat. Critical habitats, geographical areas that are considered essential to the conservation of a species and that may require special management considerations or protection, such as parts of the Florida Everglades, may be designated and protected under the ESA. Data sources can include records maintained by the U.S. FWS, the state Natural Heritage Program, or other governmental and academic agencies.

3.11.4.3 Migratory Birds

Waterfowl

The four migratory waterfowl flyways shown in Figure 3-13 (Pacific, Central, Mississippi, and Atlantic flyways) represent some of the traditional routes for fall and spring migration of certain North American migratory waterfowl such as geese, swans, and cranes. To maintain migratory waterfowl populations, an adequate amount of open space, open water, and wetlands is necessary for foraging and refuge during migration. Wetlands also provide important breeding habitat for migratory waterfowl. Major breeding areas occur in the northern United States and Alaska. During the winter months, waterfowl migrate to the southern United States and Central America, where they congregate in wetland regions. Breeding and overwintering areas of ducks are shown on Figure 3-14 (CEQ, 1989; U.S. FWS, 1979).

Other Migratory Birds

The migratory routes shown in Figure 3-13 are a simplified method of illustrating migration paths used by certain types of waterfowl. Many other species of migratory birds follow different north-south routes across the CONUS, often changing their migration paths from one year to the next. Typically smaller birds such as rails, flycatchers, most sparrows, warblers, vireos, thrushes and shorebirds migrate at night. Day migrants include large and small birds such as gulls, pelicans, hawks, swallows, nighthawks, and swifts (U.S. FWS, 1979). Data sources could include U.S. FWS records,

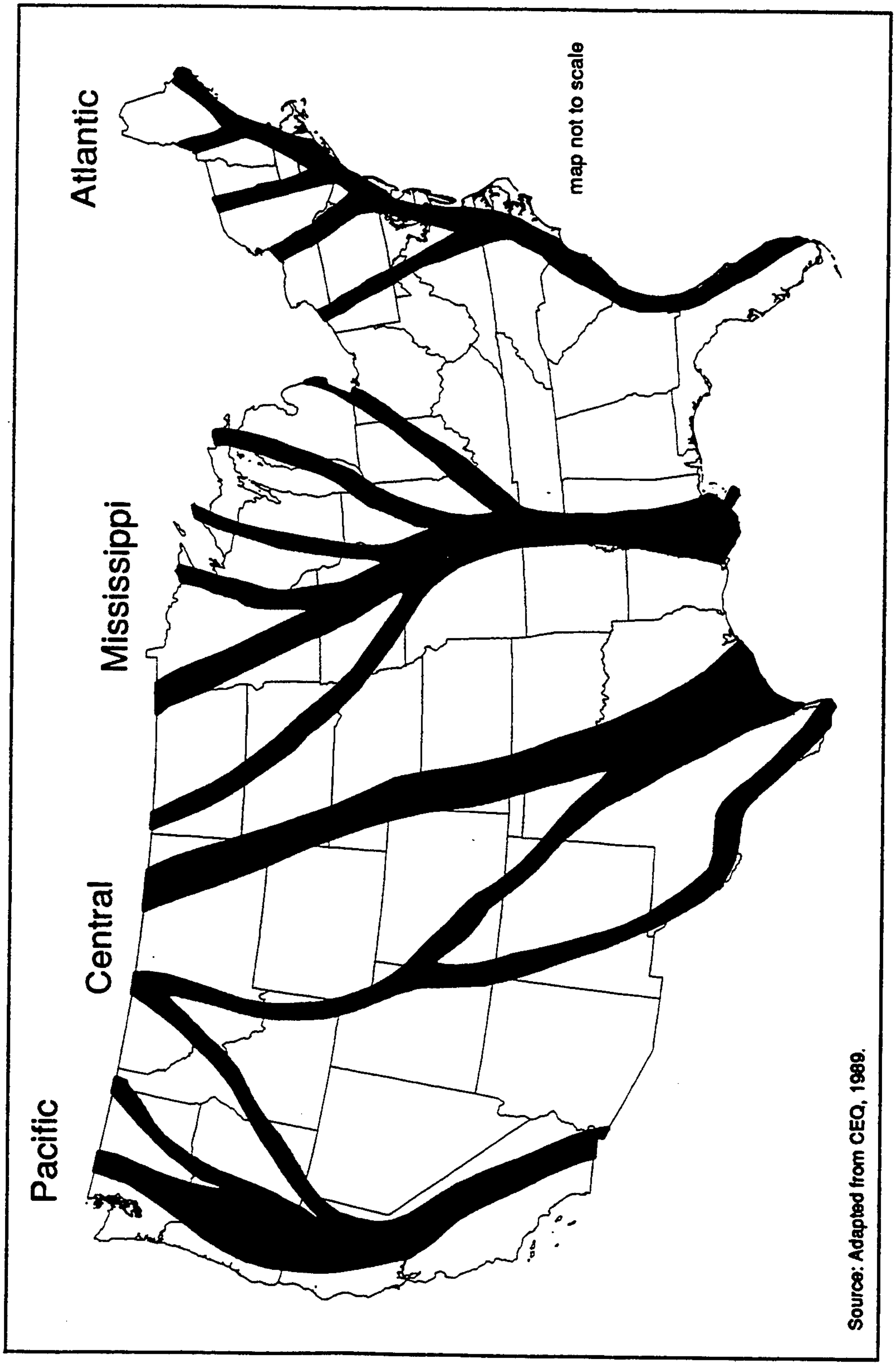


Figure 3-13. Flyways of North American Waterfowl

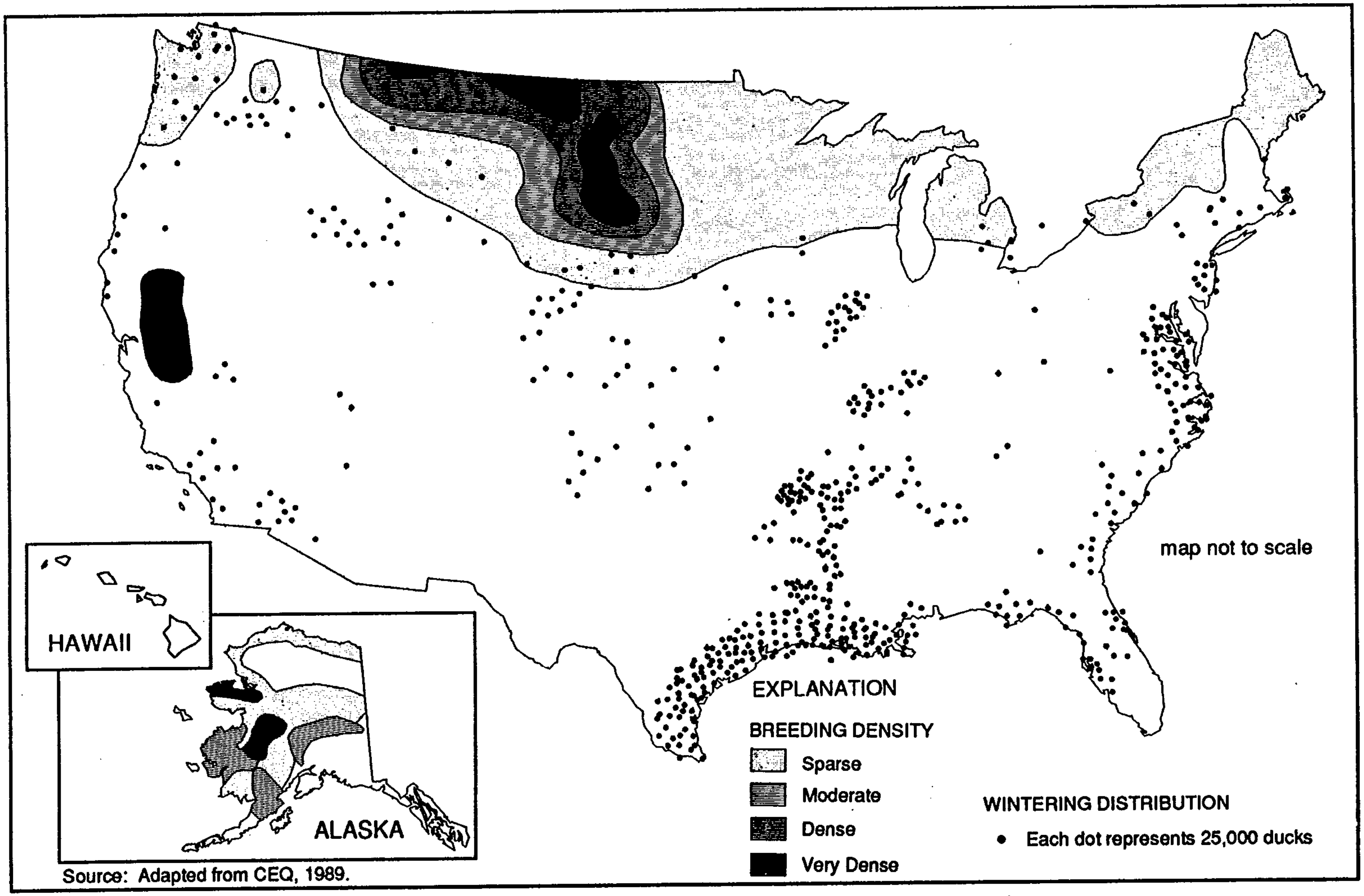


Figure 3-14. Distribution of North American Breeding and Wintering Ducks

other state and local agencies, local birding groups, and academic institutions.

3.11.4.4 Wetlands

Distribution of wetlands by state is shown on Figure 3-15. Although wetlands occur in all parts of the ROA, they are most prevalent in Alaska and the northeast, mid-Atlantic, southeast, and south-central regions of the United States. Wetlands serve important functions, including maintaining water quality, controlling floodwaters, stabilizing shorelines, and providing animal habitat and recreational uses such as hunting and fishing. Wetlands are also important in providing habitat for aquatic organisms and migratory birds, as well as for threatened and endangered plants and animals.

Data sources could include National Wetland Inventory (NWI) maps prepared by the U.S. FWS, other published wetland surveys, soil surveys, aerial photographs, and (if necessary) field delineations using procedures developed by the U.S. Army Corps of Engineers (Environmental Laboratory, 1987).

3.12 LAND USE

3.12.1 DEFINITION OF TOPIC

Land use can be defined as the human use of land resources for residential, recreational, religious, and aesthetic purposes, for economic production, or for natural resource protection. The United States has a land area of 931 million hectares (2.3 billion acres). In 1987, approximately 188 million hectares (464 million acres) were cropland, 239 million hectares (591 million acres) were grazing land, 262 million hectares (648 million acres) were forest land, 113 million hectares (279 million acres) were used for special purposes (such as protection of recreation and wildlife resources, various public installations and facilities, and farmsteads), and 115 million hectares (283 million acres) were in other land uses such as urban or other noninventoried uses (CEQ, 1989).

The land base within the United States encompasses wide variations in land cover. These variations have led to diversity in the types of land uses. Due to the interrelation of land use with other resources, land use at any site can be directly or indirectly affected by land uses of adjacent or even distant areas. Changes in land use may have both beneficial and adverse impacts on other resources.

Land under federal jurisdiction includes national parks, national forests, national grasslands, national wildlife refuges, national scenic waterways, wilderness areas, wilderness study areas, Native American lands, and other land federally protected, owned, or managed by Federal agencies. On the

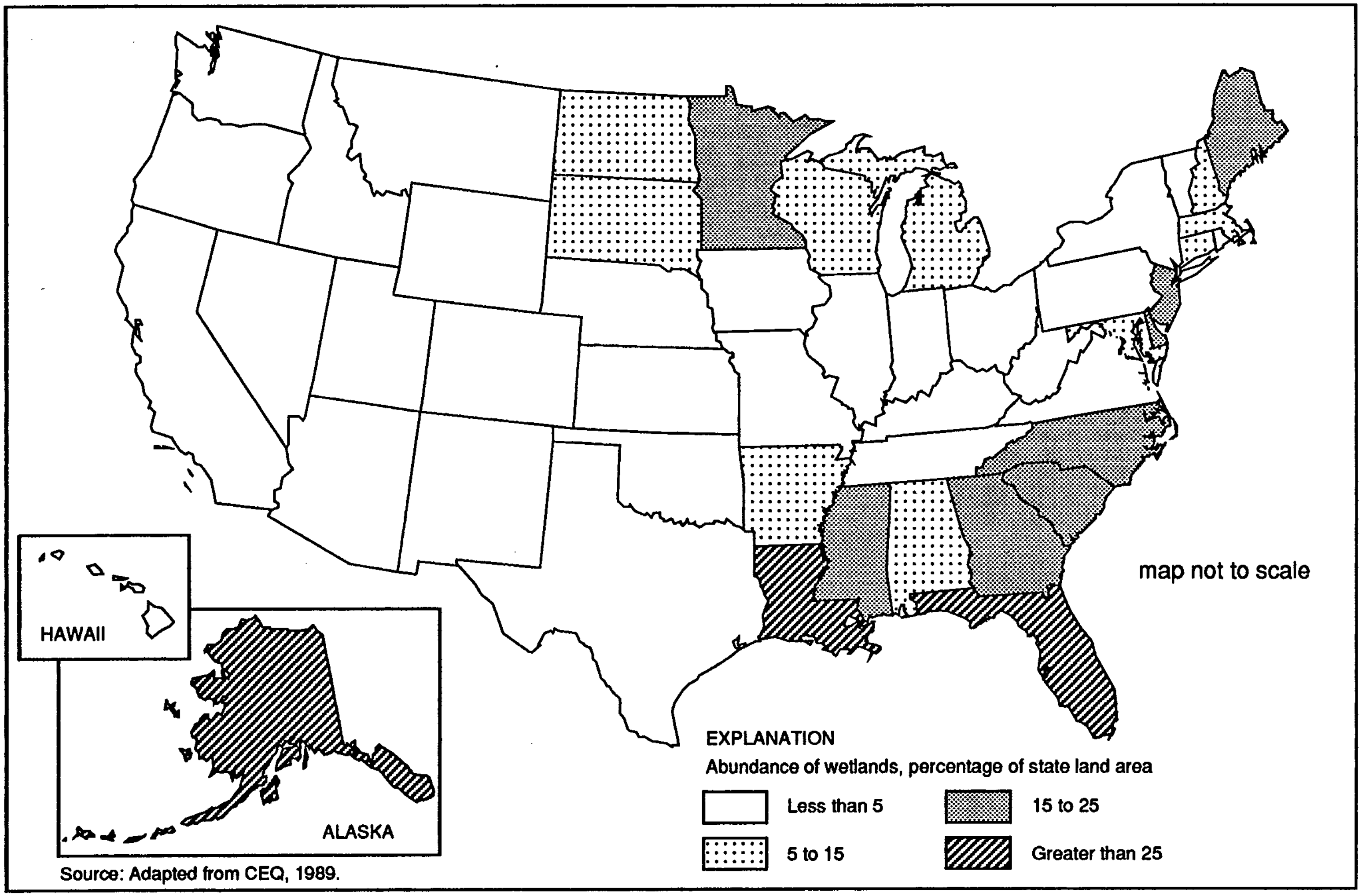


Figure 3-15. Distribution of Wetlands in the United States

state level, restrictions on land use can include state parks, state conservation districts, growth management regulations, and state-wide air and water quality regulations. Each of these restrictions can limit the type and density of development. On a regional or local (municipality) level, zoning ordinances that restrict the type and amount of development allowed within a specified area are common.

3.12.2 ISSUES AND CONCERNS

Issues and concerns affecting land use include:

- Depending on its use, location, and ownership, a tract of land may be subject to regulation by federal, state, and/or local government entities.

- Restrictions and regulations pertaining to land use can result from the proximity of land to sensitive natural areas (such as waterways, watersheds, wetlands, coastal areas, or habitat for sensitive species) (Section 3.11) or to sensitive cultural resources (Section 3.10). Such areas are particularly sensitive to external impacts. Any development near these areas generally has to comply with any regulations and management plans of the responsible jurisdiction.

- Land uses can be incompatible with the use of nearby land. For example, use of land near a school or hospital for a manufacturing facility can adversely affect the ability of the school or hospital to function effectively. Many municipalities have enacted zoning ordinances to help prevent the establishment of incompatible land uses.

- Incompatible land uses can reduce the value of nearby land. For example, construction of a railroad or a quarry in a residential area can depress the value of homes.

3.12.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An appropriate ROI for land use would encompass all land subject to impacts, either directly or indirectly, from each BMD activity. Not all potentially affected land would necessarily be adjacent to the activity. For example, an activity that produces noise or air emissions could affect distant lands. For that activity, the ROI would include all land containing noise receptors within the distance that the noise could travel and all land that could experience impacts to air quality.

3.12.4 RANGE OF CONDITIONS

The ROA encompasses a wide range of land-cover types, from desert to forest to tundra to coastal areas. Potential sites range from those that are

virtually devoid of human inhabitants to those that are densely populated. Potential Government facilities that could accommodate BMD activities are found in several locations throughout the ROA.

Most Government facility sites that could accommodate BMD activities are in non-urban regions, while most contractor sites are in metropolitan areas. Adjacent land uses vary widely, including desert, forest, grassland, grazing land, and cropland, in addition to small towns and large urban areas. Many sites could be adjacent to or near protected areas, such as national or state forests, cultural or historic sites, wildlife refuges, or natural resource conservation districts. Many sites could be in coastal areas, where certain activities could be intrusive. Some sites may be near (or include) wetlands (Section 3.11), floodplains (Section 3.7), or prime farmland (Section 3.14). Sites in congested areas could be limited in the number of new employees that could be accommodated because of lack of sufficient room for expansion.

3.13 SOCIOECONOMICS

3.13.1 DEFINITION OF TOPIC

Socioeconomics encompasses the social, economic, and demographic variables associated with community growth and development, which have the potential to be either directly or indirectly affected by external events such as changes in public policy. Social consequences (e.g., adverse health effects from poor air quality conditions) affect the overall quality of life enjoyed by the residents of a community. Economic consequences (e.g., increased health care costs) affect business activities, market structures, procurement methods, and dissemination of goods within and between communities. Demographic consequences (e.g., out-migration of firms and labor because of increased business costs) affect size, distribution, and composition of community population (Murdock, 1979). A community can be described as a dynamic socioeconomic system, where physical and human resources, technology, social and economic institutions, and natural resources interrelate to create new products, processes, and services to meet consumer demands. The measure of a community's ability to support these demands depends on its ability to respond to changing environmental, social, economic, and demographic conditions.

3.13.2 ISSUES AND CONCERNS

The primary focus of this PEIS relative to socioeconomics is the relationship between the *factors of production* (defined as labor, capital, or land necessary to produce a certain good or service) and a community's ability to accommodate or absorb these demands. See Appendix K for a complete description of economic terms.

Socioeconomic issues and concerns focus primarily on how changes in regional economic activity facilitated by operation and/or construction of a proposed BMD activity might affect the demographic composition and economic capacity of a host community and in turn, potentially affect both the human and natural environment of a region. In determining the nature and extent of the socioeconomic impacts associated with BMD activities, two categories of analysis exist for assessing BMD activities: programmatic and regional/local. To discern potential impacts at the program-related/non-site-specific level, socioeconomic issues and concerns depend on the labor, capital, and land required to support the total activity life cycle, irrespective of geographic location. For example, would the proposed activity have construction and/or operations requirements? Would it require labor, capital, and/or land? Answers to these questions lead to one of the following determinations:

- Program requirements would not be anticipated to cause impacts; therefore, no further environmental analysis would be required; or

- Further environmental analysis would be required to determine the extent of potential impacts.

At the regional/local level, assessments of potential socioeconomic impacts would be based on more specific information about the program's requirements and the socioeconomic characteristics of a region or host community. See Appendix K, section K.3.1. for a complete discussion of regional/local level issues and concerns.

At the programmatic level, labor, capital, and land required to support the BMD program would be the primary determinant of the levels of analysis and impacts. At this level, the exact geographic location, duration of activity, demographic composition, and economic structure of a local community initially would be irrelevant in determining the level of analysis required from construction and/or operation activities. Certain phases of the BMD Program would not require additional labor, capital, or land, and are assumed to have no adverse socioeconomic effects at this level. Decisions on the following variables would be required for non-site-specific analysis, determining the potential for further environmental analysis:

- Phase Demand Requirements. Would the proposed activity have operation and/or construction phase demand requirements? All activities either would have a construction and/or operation component.

- Factors of Production. Would the proposed activity require labor, capital, and/or land? Although exact requirements might be unknown at the programmatic level, applying the simple

"yes/no" criterion for resource requirements would be adequate to determine the level of analysis.

- Labor Resources. Would the required labor be supplied from current site personnel employed at an existing/proposed facility/site or would new/additional personnel be required?

- Capital/Land Resources. Would the capital or raw materials and natural resources be supplied by current inventories at an existing/proposed facility/site, or would inventory levels and composition change to accommodate new/additional capital investment and/or increased demand for raw materials or commodities?

- Sources (if applicable) of Additional Labor. Would the additional personnel be supplied from the local labor market in a host community or would in-migration of labor from outside the region occur?

- Additional Sources (if applicable) of Additional Capital/Land. Would the additional capital, raw material, or natural resource requirements be supplied from within the local economy or from sources outside the region?

3.13.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

The ROI would vary with the category of analysis (programmatic versus regional/local) and associated issues and concerns.

At the regional or local level, the ROI would be dependent on the geographic location and could vary for different socioeconomic variables. For employment, population, housing, and income, the ROI would be based on the anticipated residential distribution of project workers and regional economic interaction and linkage. For public services, finance, and education, the ROI would contain all principal jurisdictions and school districts likely to be affected by the proposed activity. The ROI for transportation would be the existing principal road, air, and rail networks required to support the proposed activity. The ROI for assessing utility system impacts would be the service areas of each utility purveyor serving the community most affected by the proposed activity.

3.13.4 RANGE OF CONDITIONS

The range of conditions at the programmatic level would not be geographically oriented, but rather would be dependent on factors of production requirements.

Given that BMD activities could be conducted at almost any location, program requirements and typical community types, relative to capacity for labor and capital stock, determine levels of analysis. With respect to socioeconomics, communities within the ROI may be classified into four categories or community types: uninhabited regions, rural areas/small communities, medium-size communities, and large metropolitan areas. Although testing and evaluation activities would primarily be conducted at existing facilities, exact locations and labor requirements are unknown at the programmatic level.

Communities of each category typically differ in terms of size and diversification. The vulnerability or susceptibility of a local community to changes in the economic base depends, in large part, on the strength of its economic base, as indicated by its number of employment sectors, its diversification of employment sectors, its pool of available labor, and its degree of inter-industry linkage. Inter-industry linkage is defined as an economic relationship between two or more industries within the same market. A well-developed network of mutually supporting industries insulates a local economy from factors outside the region and contributes to a strong economic base. Communities with strong economic bases are not affected by socioeconomic change as much as are communities which have economic bases that rely on a single basic employment sector (Klosterman, 1990).

Typical characteristics of the four socioeconomic categories of communities include:

- Uninhabited Regions. This category includes unpopulated portions of the United States, U.S. territories, foreign lands, or open ocean. Economic activity is nonexistent, and the primary issue is the availability and suitability of infrastructure and transportation networks to support an activity.

- Rural Areas/Small Communities. This category includes rural areas or small communities with populations of less than 50,000. These are small business centers, and have a small work force and little diversification of industries and employment. Some of these areas are isolated areas in hilly or mountainous regions (primarily in the West or South) whose local importance is unquestioned but whose tributary areas are too small to support a larger business center (Rand McNally, 1992). Public services, infrastructure, and transportation networks are generally limited; however, capacity of services would vary with each location. Small towns generally have small, specialized economies and relatively large basic sectors dependent on export activities (Klosterman, 1990).

- Medium-Sized Communities. This category includes areas with populations typical of an MSA. An MSA is defined as an area

with a city of at least 50,000 in population or an urbanized area of at least 50,000 with a total metropolitan population of at least 100,000 (Rand McNally, 1992). These communities usually operate as local to regional centers for economic activity. A local center usually has the largest community within a radius of approximately 50 miles; however, a larger regional or nationwide center is nearby for wholesaling, finance, and similar activities that do not involve the consumer directly. A regional center usually would be the largest community within a radius of 100 to 150 miles. This area serves as a wholesaling center and headquarters of many regional businesses. The number of employment sectors is higher than in small communities, and economic relationships would exist between only a limited number of industries. Public services, transportation networks, and other infrastructure would tend to be more extensive than in smaller communities.

- Large Communities. This category includes communities with populations similar to those of a Consolidated Metropolitan Statistical Area (CMSA). A CMSA consists of two or more primary MSAs that can be considered a single unit for statistical purposes because of economic and social integration. To qualify as a CMSA, the metropolitan area as a whole must have a population of at least 1 million (Rand McNally, 1992). These communities usually are independent centers of large-scale financial, wholesaling, and service activity. These areas typically have high population densities and numerous employment sectors. Economically supportive relationships between industries are well developed, and a large pool of available labor exists. These areas are well served by public services and infrastructure; however, major transportation networks may be operating at, near, or over capacity. Large and diversified metropolitan regions, which provide a wide range of goods and services to local residents, generally have a relatively small export or basic sector (Klosterman, 1990).

3.14 GEOLOGY, SOILS, AND PRIME AND UNIQUE FARMLAND

3.14.1 DEFINITION OF TOPIC

Geologic resources include minerals (such as metallic ores); non-metallic and industrial minerals (such as limestone, diatomite, and sand and gravel); fossil fuel energy resources (such as coal, oil, and natural gas); and unique geologic features. Geologic hazards include seismic activity (earthquakes), faults, volcanoes, tsunamis, landslides, and land subsidence.

Soil is defined as the loose surface material of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts. Prime farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage,

oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion (7 USC 4201). Unique farmland is land other than prime farmland that is used for production of specific high-value food and fiber crops (7 USC 4201). Prime and unique farmlands are protected from conversion to other uses by federal agencies under the Farmland Protection Policy Act (FPPA) (7 USC 4201 et seq.). Certain other lands, termed Farmlands of Statewide and Local Importance, that are designated by state and local governments in conjunction with the Secretary of Agriculture are also protected under the FPPA.

3.14.2 ISSUES AND CONCERNS

Issues and concerns involving geologic resources and hazards include the following:

- Access to Mineral Resources. Land uses related to the Preferred Action or alternatives could restrict access to mineral or fossil fuel energy resources, including strategic or economically important resources and deposits.

- Loss of Unique Geologic Resources. Unique and irreplaceable geologic features (such as regionally unique rock formations and uniquely shaped rock outcrops) could be destroyed during new construction, blasting, and other land-disturbing activities.

- Damage and injury from Earthquakes, Faults, or Volcanic Activity. Siting facilities in areas of risk from geologic hazards such as seismic events (earthquakes), faults, or volcanic activity could put facilities, workers, and visitors in jeopardy. Earthquake-induced sea waves (tsunamis) could also jeopardize facilities and personnel.

- Inducement of Geologic Hazards. Blasting, detonation, or intensive earthmoving activities in areas of weakly consolidated soils or highly fissured rock could lead to landslides and other geologic hazards.

- Land Subsidence. Land subsidence occurs when fluids (such as water or petroleum) are removed from porous underground rocks and weakly consolidated sediments, causing these materials to compact and the ground to settle. Sinkholes, a form of land subsidence, are thought to be triggered by fluctuations in the water table. Both forms of subsidence could cause damage to structures and infrastructure.

Issues and concerns involving soils include the following:

- Soil Erosion. Accelerated wind and water erosion of soils could occur if human activities disrupt the vegetative cover that stabilizes the soil. The adverse effects of soil erosion include topsoil loss, sediment deposition in streams or rivers, and degradation of air quality caused by fugitive dust emissions.

- Irreversible Mixing of Soil Cross Sections. Clearing and grading activities could alter the chemical and physical properties of the soil, causing long-term loss of soil productivity.

- Soil Contamination. Spills or leaks of hazardous materials could irreversibly contaminate soils through adhesion to soil particles. Contaminated soils could require excavation and disposal and could contribute to contamination of the groundwater.

- Loss of Agricultural Capacity Due to Loss of Prime and Unique Farmland. A Congressional Statement of Findings leading to the passage of the FPPA concluded that the nation's farmland is a unique natural resource and provides food and fiber necessary for the continued welfare of the people of the United States. Each year, a large amount of the nation's farmland is irrevocably converted from actual or potential agricultural use to nonagricultural use. Continued decrease in the nation's farmland base may threaten the ability of the United States to produce food and fiber in sufficient quantities to meet domestic needs and the demands of export markets (7 USC 4201). Even minor or temporary disturbances of prime or unique farmland could irreversibly alter the physical and structural characteristics that render the soil suitable for crop production.

3.14.3 APPROACH TO DEFINING THE REGION OF INFLUENCE

An ROI for geologic resources, soils, and prime and unique farmland would encompass all areas subject to physical disturbance by BMD activities. Also, because certain BMD activities could involve launches, blasting, or other operations that could affect geologic resources, soils, and prime and unique farmland in adjoining lands, the ROI could include some adjacent areas.

3.14.4 RANGE OF CONDITIONS

The ROA includes a variety of geologic settings, including stable continental crust, interior basins, mountain ranges, intermountain valleys and plateaus, coastal plains, islands, and atolls. Surficial deposits range from agricultural soils to glacial till.

3.14.4.1 Geologic Resources and Hazards

Mineral and energy resources, such as oil fields, coal deposits, and deposits of precious metals or strategically important minerals, occur in widely scattered areas throughout the ROA. Unique geologic features such as geysers and uniquely shaped rock outcrops are generally found in geologically active areas.

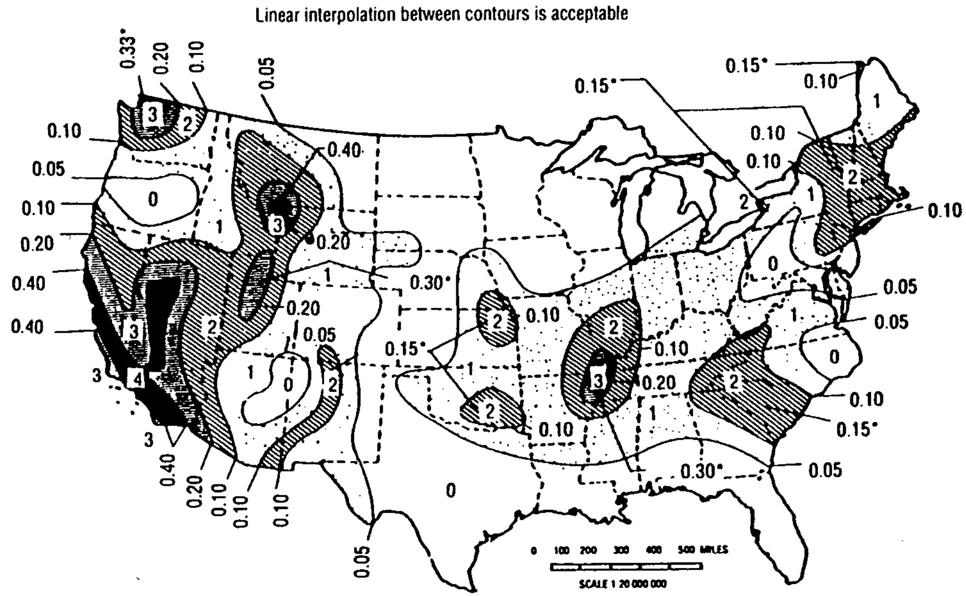
Minor earthquakes occur over much of the United States, but severe seismic events tend to be concentrated in certain areas. Figure 3-16 shows seismic zones of the United States (BOCA, 1989). The categories shown on Figure 3-16 range from 0g (effective peak acceleration <0.05g) for zones with little potential for damaging earthquakes, to 4g (effective peak acceleration >0.40g) for zones with the potential for severe earth movements. Some of this seismic activity, such as that occurring in California, is associated with subsurface faulting that reaches the earth's surface. Seismic activity in the central and eastern United States is associated with deep earth movements that do not result in major surface faulting.

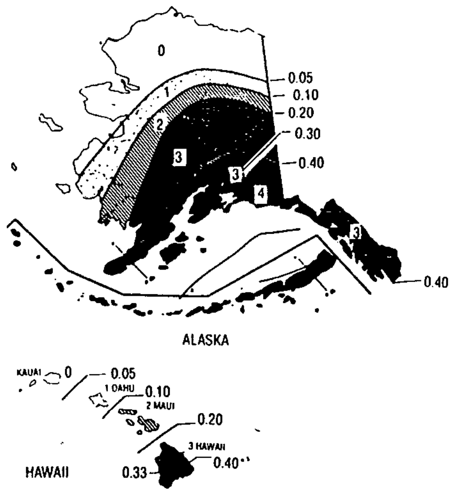
Tsunamis, which are produced from earthquakes, are possible in coastal areas. Destructive tsunamis are relatively rare and are usually confined to the Pacific Ocean. In the United States, tsunamis occur approximately once every 8 years (Keller, 1979).

On a worldwide basis, volcanic activity is a relatively uncommon process. However, volcanic eruptions can be tremendously destructive, as evidenced by the recent eruption of Mount Pinatubo in the Philippines and the resulting damage to Clark Air Force Base. In the United States, several active volcanoes occur in Hawaii, several in the Cascade Range of the Pacific Northwest, and approximately 25 in the Aleutian Islands and southern coast of Alaska. Approximately 80 percent of the world's volcanoes are located on the Pacific Ocean rim (Keller, 1979).

Landslides can occur on steep slopes, coastal bluffs, and riverbanks. Locations with certain fracture or bedding attitude, soil moisture, and soil composition are particularly susceptible, as are slopes over-steepened or undercut by stream erosion or human activity. Areas susceptible to landslides are widespread throughout the United States but are generally confined to areas of steep slopes.

Areas with high rates of groundwater and petroleum extraction are vulnerable to land subsidence. Examples of this type of subsidence include the San Joaquin Valley of central California and the eastern desert basins of California. Subsidence due to sinkhole formation occurs in limestone bedrock in Florida, Alabama, and other regions on the southeast and east coasts.





EXPLANATION

X	Seismic zone
X.XX	Effective peak velocity-related acceleration (A_V)
▬	$A_V \geq 0.40$
*	Represents the maximum value in the center of the zone

Source: Adapted from BOCA, 1989.

Figure 3-16. Map of Seismic Zones and Effective Peak Velocity-Related Acceleration (A_V) in the United States

3.14.4.2 Soil Resources

The ROA includes a wide range of soil types. The susceptibility of soil resources to degradation is dependent on climatic conditions, soil type, and other local conditions. Soil surveys have been prepared by the U.S. Soil Conservation Service for most counties throughout the ROA. These surveys show the areal extent of soil series (mapping units) and provide descriptions of the physical properties of each soil series.

Figure 3-17 presents the areas with the greatest amount of soil erosion in the United States. Accelerated erosion can occur wherever human activities disrupt the vegetative cover that stabilizes surface soil horizons. Soils are most susceptible to wind and water erosion in late winter and early spring, when the winds generally blow the strongest, snowmelt and spring rains begin, and vegetative cover is the least (CEQ, 1989). The exact extent of accelerated wind and water erosion of soils resulting from the removal of surface vegetation depends on local soil type, topography, and other local conditions.

The greatest vulnerability to wind erosion generally occurs in windy, dry climates, particularly in broad, flat areas with fine-grained, loose sandy soils, and sparse or disturbed vegetation. Areas of high wind erosion are particularly common in the western half of the nation, especially in the desert southwestern portion. Moist climates, where soils tend to be more cohesive and protected by vegetation, are generally less susceptible to wind erosion. Lower wind erosion rates occur in the northeastern and southeastern United States.

Susceptibility to water erosion is a function of soil cohesion, drainage characteristics, the length and degree of slope, the amount of rainfall or water flow in excess of the infiltration capacity of the soil, vegetative cover, and land management practices. Water erosion is generally highest in regions that experience sustained periods of intense rainfall. Soils most susceptible to water erosion are loose, sandy soils on long, steep slopes, particularly in areas of ground disturbance. In the United States, states experiencing the most water erosion have historically been in the Midwestern Corn Belt, the southeast, and the mid-Atlantic region.

3.14.4.3 Prime and Unique Farmlands

Figure 3-18 presents the distribution of prime farmland acreage, by state, in the United States. Domestic crops and agricultural exports are primarily produced on prime farmland. Unique farmlands or farmlands of statewide or local importance are generally designated by state agricultural agencies. Prime and unique farmlands are most prevalent in settings such as nearly level coastal plains, coastal basins, and the Great Plains, and much less prevalent in deserts, tundra and other very cold areas, and mountainous areas.

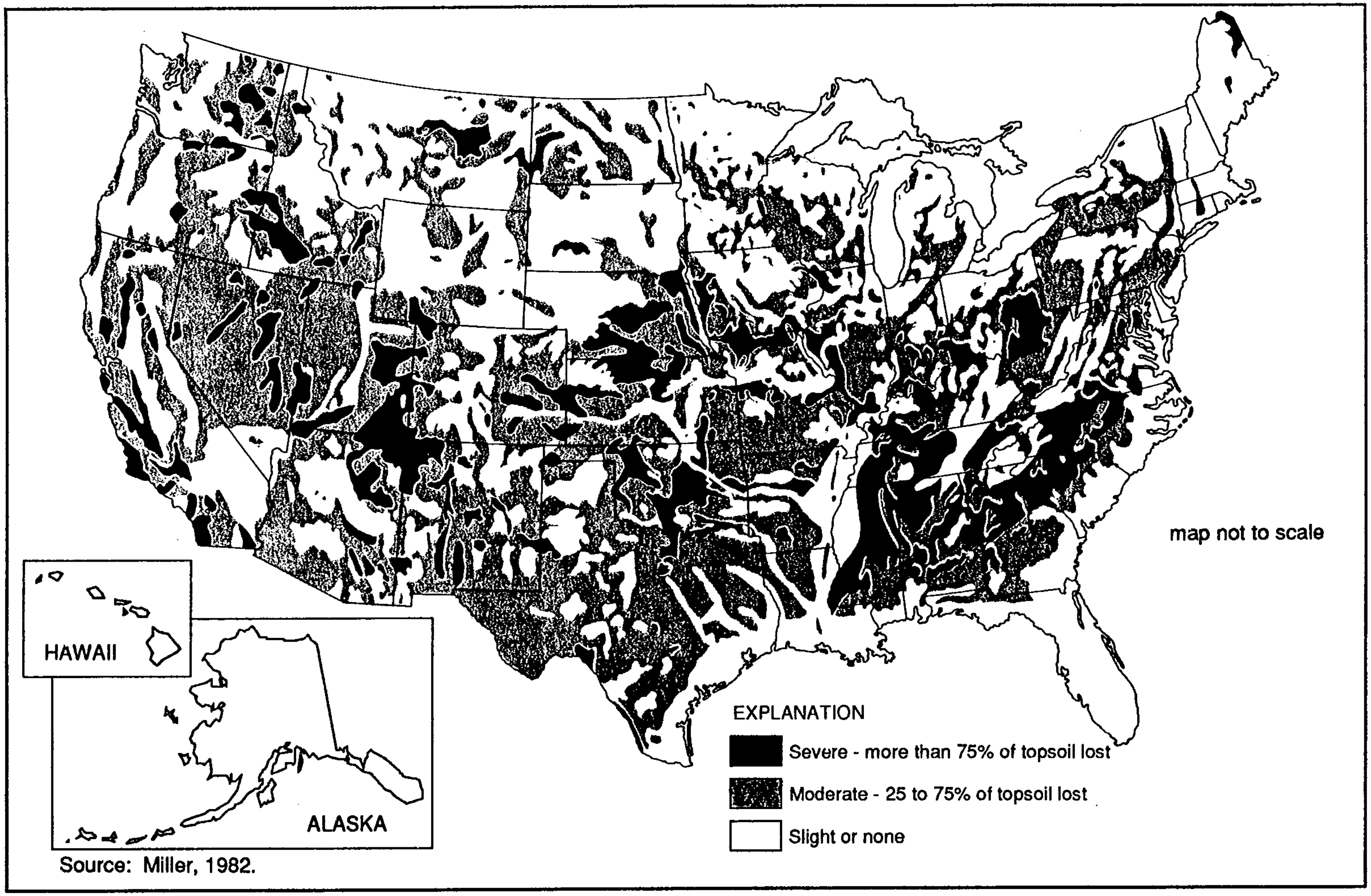


Figure 3-17. Soil Erosion in the United States

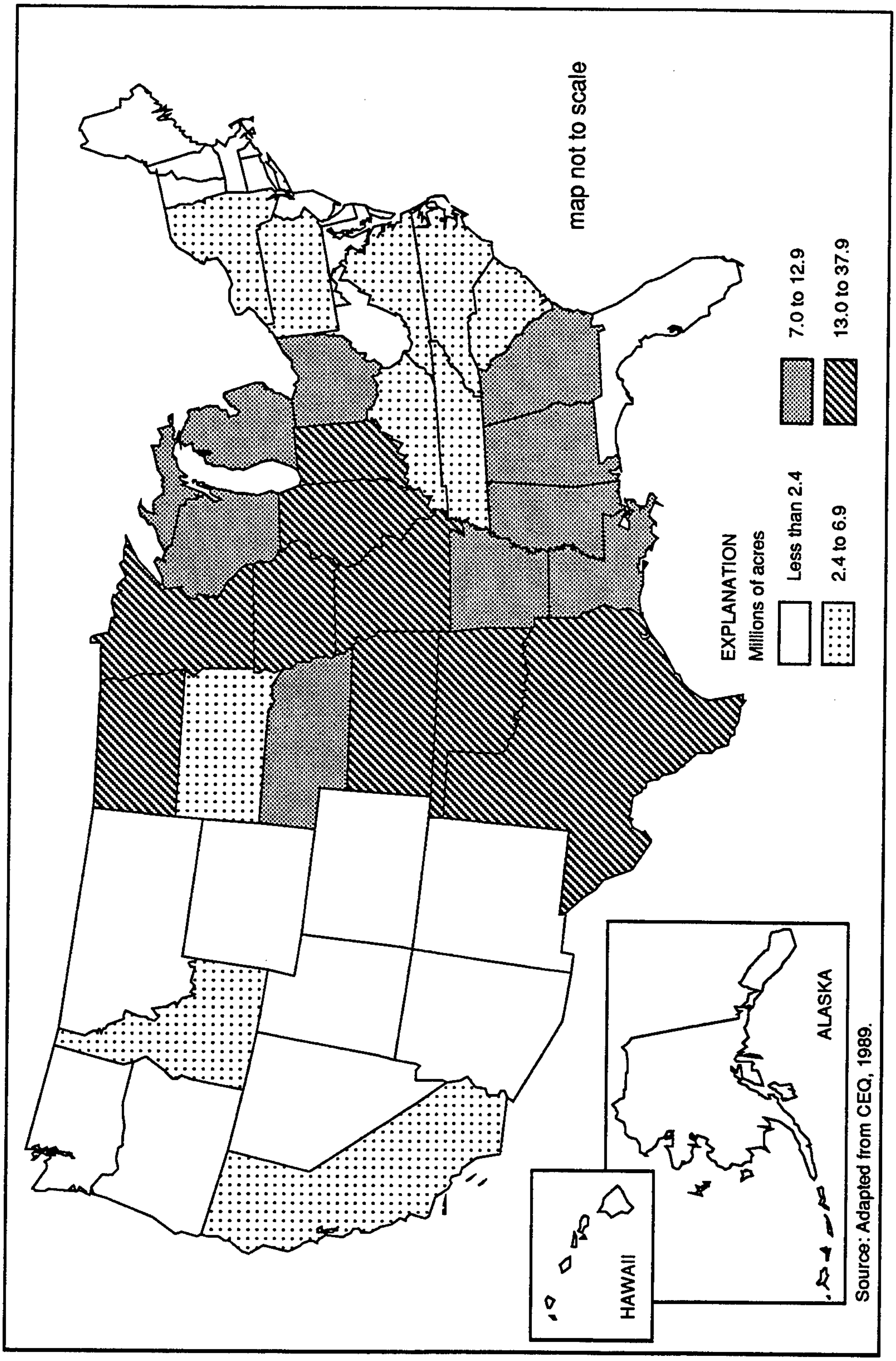


Figure 3-18. Distribution of Prime Farmland in the United States

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Chapter 4

Environmental Consequences

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter assesses potential environmental consequences from the National Missile Defense (NMD) Program under the Preferred Action (continued Technology Readiness Program), and each System Acquisition Alternative described in Chapter 2 against the affected environment presented in Chapter 3. The environmental consequences of each Alternative are summarized and compared in Section 2.7 of Chapter 2. Sections 4.1 through 4.14 assess environmental consequences with respect to each of the environmental topics addressed in Chapter 3.

Environmental consequences are assessed at a programmatic level necessary to support a decision to proceed with the NMD Program under the Preferred Action or one of the Alternatives. The environmental consequences of specific NMD activities at specific sites are not considered. Future environmental documentation would be prepared as necessary to support decisions to proceed with specific activities.

The assessment of environmental consequences for each topic is followed by a discussion of mitigation measures (defined in 40 CFR 1508.20) which could be implemented to prevent or offset those consequences. Although commitments to mitigation measures would be made only following decisions to proceed with specific NMD activities, information as to what mitigation measures are available is still necessary to support programmatic decisions. Actual commitments to implement specific mitigation measures would be made as necessary in future environmental documentation.

The Preferred Action is a continued Technology Readiness Program involving research and development of NMD elements without proceeding into the acquisition of an NMD system. For each System Acquisition Alternative, environmental consequences are assessed in detail only for the development and testing life-cycle phase. A brief discussion of environmental consequences for the later life-cycle phases is also provided for environmental planning purposes.

Section 4.15 considers cumulative impacts (defined in 40 CFR 1508.7) potentially resulting from the Preferred Action and System Acquisition Alternatives and TMD activities. The discussion focuses on the cumulative impacts from Ballistic Missile Defense (BMD) activities under the NMD Program, considered in this document, and BMD activities under the Theater Missile Defense (TMD) Program, considered in the TMD Programmatic Environmental Impact Statement (PEIS) (BMDO, 1993).

The Theater Missile Defense Final Environmental Impact Statement (FEIS) found no unavoidable, significant environmental impacts for the Proposed Action or any of the four Alternatives (BMDO, 1993). The Proposed Action

would involve research and development activities that would give the United States the capability to produce and deploy an integrated, comprehensive TMD system which would include a mix of Active and Passive Defenses, and Counterforce. Alternative 1, Improve Active Defense Only, would involve improvements in the areas of interception and destruction of in-flight theater missiles. Alternative 2, Improve Counterforce Only, would involve improvements in the areas of detection, identification, and destruction of fixed and mobile launch platforms; support and storage facilities; and command and control nodes. Alternative 3, Improve Passive Defense Only, would involve improvements in the areas of camouflage, cover, and deception; hardening of military assets; reduction in thermal and electronic emissions; and mobility. Alternative 4, No-Action, would involve no new research, development, testing, production, or basing. Any unavoidable effect, such as construction noise, would be temporary and not significant. Any significant impact, such as destruction of archeological artifacts during construction, would be readily avoided by taking normal precautions and following standard procedures.

Section 4.16 is a consideration of irreversible and irretrievable commitments of resources associated with the Preferred Action and System Acquisition Alternatives.

4.1 AIR QUALITY

Activities under the Preferred Action and the development and testing life-cycle phase of the System Acquisition Alternatives would involve the handling of substances listed as hazardous air pollutants (HAPs) under the Clean Air Act Amendments of 1990 (CAAA) and the generation of exhaust clouds from rocket and ground-based interceptor (GBI) launches. Emissions would generally be minimal in magnitude and brief in duration. Based on previously published analyses for similar Department of Defense (DoD) and National Aeronautics and Space Administration (NASA) programs, emissions should remain below regulatory thresholds established in the National Ambient Air Quality Standards (NAAQS, 40 CFR 50), by states, and by the National Emissions Standards for Hazardous Air Pollutants (NESHAPS, 40 CFR 61). Even though emissions from future Preferred Action activities will not be continuous, Prevention of Significant Deterioration Regulations (PSDs) will limit allowable increments in BMD-related pollutant emissions in areas without existing pollution problems. In areas with existing pollution problems, strict pollution permits may be required for the siting process. Emissions from the later life-cycle phases of the System Acquisition Alternatives could be higher, but would still remain below all applicable regulatory standards.

4.1.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.1.1.1 Environmental Consequences

Ground-Based Interceptors

Fabricating seeker/sensor units to test GBIs would require the use of compounds of beryllium and mercury that are subject to federal emissions regulations under the NESHAPs. Several other HAPs covered under the CAAA (but for which NESHAPs have not yet been promulgated) would be used in fabricating seeker units. Examples include several compounds of arsenic, antimony, cadmium, and indium. Fabrication would be limited, including one-of-a-kind and few-of-a-kind items from raw materials produced intermittently and would not present an unacceptable public health risk.

The GBI boost vehicles (BVs) would use a solid propellant. Rockets to be used include Delta and Minuteman classes. Propellants include mixtures combining aluminum or boron (fuels) with ammonium perchlorate or ammonium nitrate (oxidizers) in a rubbery binder. Combustion products from these mixtures could include carbon dioxide, carbon monoxide, hydrogen gas, hydrogen chloride, nitrogen gas, nitrogen oxides, chlorine, and aluminum oxide. Table 4-1 presents a summary of major launch effluents for Minuteman, Delta II, Space Shuttle, and Titan IV launches.

Table 4-1. Total Launch Vehicle Effluents from 0-15 km (in tons)[1,2]

Species	Space Shuttle[3]	Titan IV	Delta II[4]	Minuteman
Al_2O_3	23.4	91.1	21.8	4.9
CO	186.7	87.0	32.0	3.9
HCl	163.3	61.8	17.6	3.4
CO_2	27.4	10.2	11.1	0.7
N_2	67.9	26.6	8.9	1.4

[1]Amounts are for nozzle exhaust only and do not include any conversion of products due to afterburning or atmospheric reaction.

[2]Note that the Space Shuttle and Titan vehicles are not part of the proposed action or alternatives.

[3]Space Shuttle figures include both the Shuttle main engines (liquid propellant) and the solid rocket motors.

[4]Delta II figures include both the liquid-fuel core motor and the solid rocket motors.

Source: Lang, 1994.

Liquid propellants for the GBI kill vehicle (KV) would be used in the attitude control and divert thrusters in the KV. Propellants would be formulated, handled, and stored at contractor and Government facilities. Vapors would be produced during the storage and transfer of propellants. Emissions of vapors could be minimized by the use of vapor recovery systems, vapor incineration systems, and oxidizer vapor recovery systems (SDIO, 1991a). The incineration products could include hydrocarbons, nitrogen oxides, and sulfur oxides. The facility emitting these waste products would need to ensure compliance with emission standards for these pollutants.

Each propellant combination has its own unique properties. For example, many liquid propellants, such as nitrogen tetroxide used with a mixture of dimethylhydrazine and hydrazine, contain volatile organic compounds (VOCs). VOCs react with nitrogen oxides in the presence of sunlight to form ground-level ozone, one of the criteria pollutants. The CAAA requires states with ozone nonattainment areas (defined and discussed in Section 3.1) to reduce VOC emissions. The amount and schedule for VOC emissions reductions vary according to the degree of ozone nonattainment. Initially, any major testing involving propellants would be more easily accomplished in states in ozone attainment. The impact of VOCs and other volatile compound emissions associated with liquid propellants could be minimized or eventually phased out, as mandated by the CAAA. These emission-control strategies would be implemented by participating contractor and government facilities. As a result, VOC emissions associated with propellant formulation, handling, and storage would not be expected to have a substantial impact on air quality.

Emissions of other vapors or incineration-combustion products from propellant storage facilities would be subject to Prevention of Significant Deterioration (PSD) and New Source Review (NSR) permits on a facility-by-facility basis. Emissions to the environment from propellant storage would be in compliance with the CAAA (BMDO, 1993).

Testing GBIs would involve flight testing of missiles to demonstrate intercept of target systems. The exhaust from GBIs and other rocket systems used in GBI testing would be derived from the propellant, additives, and impurities associated with the propellant. The total emissions from the three solid propellant boosters in the Strategic Target System (STARS) has been documented (USASDC, 1992), showing emission rates of each major component that are below applicable standards. Based on the short duration of the emissions and the limited number of launches per year, impacts to air quality from launches similar to STARS launches would be minimal. Similarly, the launches of 84 Strategic Launch Vehicles (SLVs) per year were modeled for the U.S. Army Kwajalein Atoll (USAKA) High Level of Activity alternative and the concentrations of key emissions are documented in the USAKA Environmental Impact Statement (EIS) (USASSDC, 1993a). This modeling predicted annual impacts that do not exceed NAAQS. There

would be fewer than 10 GBI tests per year under the Preferred Action. The NMD program will utilize Minuteman class rockets. Table 4-1 illustrates that Minuteman and Delta rockets generally contribute much smaller quantities of effluents than do the larger Shuttle or Titan vehicles. Nonetheless, extensive pollution modeling studies would be undertaken to document the emissions from NMD launch vehicles and rocket systems.

Aluminum oxide particulate matter and carbon monoxide emissions would result from NMD development and testing launches. Dispersion of these pollutants in the ground cloud and in the exhaust plume that persists at the launch pad area during ignition and liftoff has been extensively studied for the Titan IV program. Diffusion analysis has been conducted for each space launch vehicle and rocket option (USAF, 1988). Two air dispersion models, the Products of Combustion/Atmospheric Dispersion (PCAD) model and the Industrial Source Complex-Short Term (ISCST) model, have been used. PCAD was developed to model propellants, explosives, and pyrotechnics combustion and the atmospheric dispersion of the combustion products. ISCST is approved by the U.S. Environmental Protection Agency (U.S. EPA) and has been used to evaluate ambient air impact from industrial processes.

Air pollutant emissions from space launch vehicles such as the Titan IV have been extensively studied. Profiles of peak ground-level concentrations of hydrogen chloride, particulate matter, and carbon monoxide were presented as a function of distance from the launch pad area. The profiles were prepared using typical weather parameters and expected performance and trajectories of the vehicle and other modeling assumptions. The study showed an increase in the 24-hour average concentration of particulate matter during a launch day. This figure is below the applicable NAAQS. However, because of the limited number of launches per year and the short duration of each, Titan launches do not result in any discernible increase in annual mean particulate matter levels (USAF, 1988).

Carbon monoxide, a pollutant generated by various launch vehicles, is a criteria pollutant under the NAAQS. The NASA Rocket Exhaust Emission Dispersion model shows that ground levels of carbon monoxide do not generally exceed the NAAQS except near the launch site. Due to the high temperature of the exhaust, much of the carbon monoxide oxidizes to carbon dioxide after emission. Because of the brief and sporadic nature of air emissions associated with launch programs, the long-term impacts of launches on ground-level air quality are minimal (SDIO, 1992).

Ground-Based Sensors

Transmitter capacitors and modulators used in testing ground-based sensor (GBS) radars would consist of metal plates and vacuum tubes, which could contain beryllium. As previously discussed for GBIs, beryllium is a HAP for which the U.S. EPA has established NESHAPs. Phase shifters would be

composed of ferrite. The major component would be ferric oxide combined with nickel, nickel-cobalt, manganese-magnesium, yttrium-iron garnet, or single crystal yttrium-iron garnet. Cobalt compounds, nickel compounds, and manganese compounds are listed as HAPs, but the U.S. EPA has not yet issued applicable NESHAPs.

Solid-state modules would typically be made of radiation-hardened semi-conducting materials. A common material used in fabricating solid-state modules is gallium arsenide. Arsenic compounds are HAPs, but the U.S. EPA has not yet issued applicable NESHAPs. Electronics production could involve the use of solvents to remove excess material and clean the finished product. Typical solvents would include methyl chloroform, butyl alcohol, and Freon-113. Some solvents, such as methyl chloroform, are classified as HAPs.

Space-Based Sensors

The potential launch-related air emissions from the test launches of space-based sensors (SBSs) would be similar in character to those previously described for GBIs. As many as three rockets per year could be launched to carry SBSs into space. These could include Delta IIs, Minutemen 1s (MM1s), or other similarly sized rockets. Launch, flight tracking, and other range control operations for MM1 missiles from Vandenberg Air Force Base (AFB) are part of the ongoing operations at Vandenberg AFB using existing facilities and have been previously evaluated. That evaluation revealed no significant individual or cumulative air quality impacts. Since fewer than three such launches per year are anticipated under the Preferred Action, air quality impacts are expected to be inconsequential.

4.1.1.2 Mitigation Measures

Although the air quality impacts of solid-propellant rocket motors would likely be minimal, mitigation measures would be implemented as necessary. Conducting rocket launches during dry weather could minimize the creation of hydrochloric acid in the atmosphere from the reaction of combustion products with atmospheric moisture. Launch-related air quality impacts could also be reduced by avoiding launches during low-level inversions, which inhibit pollutant dispersal (USASSDC, 1994a). Launch sites typically conduct extensive meteorological monitoring and employ technical staffs trained to monitor atmospheric conditions.

4.1.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.1.2.1 Development and Testing

Potential air quality impacts in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section 4.1.1.1 for the Preferred Action. However, there would be more launches and more pollutant releases associated with launches under this Alternative when compared to the Preferred Action. Air emissions would still be expected to be minimal and in regulatory compliance.

4.1.2.2 Later Life-Cycle Phases

Production

Production of GBIs would likely include standard industrial operations, such as metal machining, spray painting, electroplating, smelting, casting, and cleaning with solvents. The materials used (and those classified as HAPs) would generally be the same as those used in development and testing. Allowable emissions and regulated sources vary greatly from state to state. New sources and major modifications of existing sources (including increased production levels) could trigger offsetting requirements in nonattainment areas or PSD requirements in attainment areas (defined and discussed in Section 3.1). However, the use of existing facilities already permitted for the processing of hazardous material would provide the easiest means of completing the processes listed above, since the increase in emissions would be relatively minor.

The solid propellants used in the GBI BV, the solid propellants used in the main GBI KV propulsion systems, and the liquid propellants used in the KV thrusters would contain materials which are hazardous prior to combustion.

Beryllium-based fuels could be the basis for some solid propellants. Use of these fuels would be in compliance with NESHAPs for beryllium (40 CFR 61). Section 173 of the CAAA allows emissions increases from rocket engine and motor firing (and related cleaning operations) to be offset by alternative or innovative means at existing or modified major sources that test rocket motors or engines. For the offset to be allowed, the activity must be essential to national security. This provision would apply to NMD activities.

Chlorine pentafluoride and monomethyl hydrazine could be used in liquid propellants. Vapors are produced during the storage and transfer of these propellants. Prior to launches, emissions of vapors could be minimized by

the use of vapor recovery systems, vapor incineration systems, and oxidizer vapor scrubber systems (SDIO, 1991a). Typical incineration products would include hydrocarbons, nitrogen oxides, and sulfur oxides. Operations producing waste products affected by NAAQS, NESHAPs, or HAPs classification would require careful monitoring. The use of permitted facilities that already process similar materials for other applications would assist in ensuring compliance with the CAAA.

Production of radars for GBSs would likely utilize contractor facilities already equipped for electronics production. Production would utilize the same hazardous chemicals and solvents as would development and testing, except on a larger scale. Production of space-based elements could involve the processing of beryllium, for which NESHAPs have been developed.

Up to 15 launches (using Delta II or Minuteman class rockets launched from existing facilities) over a 5-year period could be necessary to deploy space-based elements. The 1988 Environmental Assessment (EA) of Titan IV operations for Vandenberg AFB (USAF, 1988) studied the air impacts for a proposed schedule of four launches per year. Impacts to air quality from fuel and oxidizer vapor emissions were found to be insignificant because emission levels were low, the occurrence of emissions was infrequent, and operations were intermittent. Emissions from the launches remained below federal, state, and local threshold criteria. Therefore, the less aggressive launch program necessary to carry space-based elements into space would be expected to meet emissions criteria for federal, state, and local regulations. However, once the launch sites and number of launches are specified, site-specific air quality studies would be undertaken.

Basing, Systems Maintenance, and Support Operations

The use of aircraft and commercial ground transportation vehicles to ship equipment from various manufacturing locations to basing locations would result in minor air emissions. Construction-related impacts could result from particulate matter and construction equipment emissions. Short-term emissions related to construction activities, such as fugitive dust and heavy equipment exhaust, would be temporary and affect only those receptors close to construction areas.

A 10- to 12-megawatt multiple unit power plant could be required at each GBS site. If these power plants are constructed, air emissions from them would be in compliance with applicable regulatory standards. Further environmental analysis could be necessary prior to power plant construction to ensure that operational emissions comply with all applicable federal, state, and local emissions requirements.

Decommissioning

The primary source of air quality impacts while NMD elements are decommissioned would be from disassembly or the destruction of rocket motors. If possible, propellant materials would be recovered and reused. Rocket fuel would be removed for reclamation or burning in a controlled environment, such as an incinerator. Where practicable, incineration or closed burning of rocket fuel would be performed. Most of the acid and particulates ejected during the burn would be collected in plume scrubber water. This water would be treated for acceptance by a publicly owned (or federally owned) water treatment works or discharged in accordance with a National Pollutant Discharge Elimination System (NPDES) permit.

Aging motors that contain flaws would likely be decommissioned using open detonation. The motor case would be ruptured lengthwise. The plume of emissions from open detonation would result in a longer burn time than that for static firing. These events would produce a less dense and more dispersed emission cloud than a static firing cloud. When the lower edge of this cloud reached the ground, it would already have a lower concentration of emissions than would the static fire methods. Therefore, the maximum ground-level concentration of emissions resulting from open detonation would be lower but last longer, since the more dispersed cloud would take longer to pass a fixed location. Contractor and government operations in open burning and open detonation would meet U.S. EPA permit specifications. Regardless of method, obsolete-missile disposal would conform to federal and state laws for minimizing air emissions.

4.1.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.1.1.2 could be applicable to this Alternative.

4.1.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.1.3.1 Development and Testing

The types of potential impacts to air quality in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.1.1.1 for the Preferred Action. However, there would be somewhat fewer launches and test-firing activities under this Alternative.

4.1.3.2 Later Life-Cycle Phases

The types of potential impacts to air quality in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.1.2.2 for the Ground- and Space-

Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. There would be no motor static firing of SBIs and SBSs. The overall magnitude of launch-related air quality impacts under this Alternative could therefore be decreased, but this Alternative could require an increase in ground support operations in areas such as munitions maintenance. These activities could utilize cleaning solvents, paints, and paint strippers, including many substances classified as VOCs.

4.1.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.1.1.2 could be applicable to this Alternative.

4.1.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.1.4.1 Development and Testing

The types of potential impacts to air quality in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.1.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, there would be more launches and more pollutant releases associated with launches under this Alternative when compared to the Preferred Action.

4.1.4.2 Later Life-Cycle Phases

The types of potential impacts to air quality in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.1.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, the overall magnitude of launch-related air quality impacts under this Alternative could be greater than for the Preferred Action.

4.1.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.1.1.2 could be applicable to this Alternative.

4.2 UPPER ATMOSPHERE

Activities under the Preferred Action and the development and testing life-cycle phase under the System Acquisition Alternatives could involve the use of small quantities of ozone-depleting compounds (ODCs). The greatest potential for impacts to the upper atmosphere would occur during launches of rockets into or through the stratosphere. Chlorine and other ozone-

depleting combustion products could also be emitted when burning propellants and fuels to test-fire GBIs and launch rockets to carry targets and space-based test elements aloft. Additionally, these test-firing and launching activities could emit carbon dioxide, water vapor, and other radiation absorbing compounds to the atmosphere, thereby contributing to global climate change. However, the emissions of ozone-depleting and radiation-absorbing compounds from NMD activities would generally be minor relative to other anthropogenic sources. In the later life-cycle phases of the System Acquisition Alternatives emissions of these compounds would also be minor, although periodically somewhat higher. Exhaust products and quantities relevant to Upper Atmosphere Chemistry are provided in Table 4-2.

Table 4-2. Ozone-Depleting Chemicals from Launch Vehicles

Vehicle	Chlorine in Stratosphere (Tons per Launch)	Alumina in Stratosphere (Tons per Launch)
Space Shuttle[1]	79	112
Titan IV[1]	48	69
Titan IV with Solid Rocket Motor Upgrade[1]	55	93
Delta II	8	12
Minuteman III	2	3

[1]These vehicles are not elements of the preferred action or alternatives.

Source: Aerospace Corporation, 1993.

4.2.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.2.1.1 Environmental Consequences

NMD activities under the Preferred Action would result in emissions of compounds capable of depleting stratospheric ozone or absorbing solar radiation, thereby contributing to global climate change.

Stratospheric Ozone

NMD activities under the Preferred Action could involve the use of small quantities of several Class I and Class II ozone-depleting compounds. For example, freon is one of several compounds which could be used for cryogenic cooling to test GBI seeker and sensor units. Electronics production to test radars associated with GBSs could require the use of ozone-depleting solvents such as chloroform. These compounds are

scheduled for phaseout by 1996, which will accelerate the use of alternate materials for further NMD activities. As the usage of ODCs for smaller processes (such as electronics processing and hand-wiping of instrument components) continues to decline, the currently unregulated usage of rockets containing chlorine will continue. Therefore, launch activities and GBI testing and firing would likely be the largest contributor to ozone depletion from BMDO activities.

Since many DOD processes are currently undergoing the transition to utilize non-ozone-depleting compounds in place of Class I or Class II ODCs, the ground emissions of ozone-depleting compounds are shrinking rapidly. There is the possibility that even after the phaseout of regulated ODCs, stockpiled reserves will remain in use for several years. However, by eliminating ozone-depleting substances from acquisition requirements and from military specifications and standards, BMDO should be able to minimize the extended usage of these substances.

The rockets to be used for the Preferred Action are Delta or Minuteman class. These rockets are fueled by solid propellant mixtures combining aluminum or fuels with ammonium perchlorate or ammonium nitrate (oxidizers) in a rubbery binder. Combustion products include chlorine, carbon dioxide, water vapor, and hydrogen chloride. Rockets could be fueled by one or more of the following propellant mixtures, with the following combustion products:

- Most current and projected solid-rocket boosters use ammonium perchlorate oxidizer and a polymer fuel (the propellant binder) loaded with powdered aluminum. The principal effluents are hydrogen chloride, aluminum oxide, water, hydrogen, carbon monoxide and carbon dioxide (AIAA, 1991).

- Chlorine pentafluoride, used as an oxidizer in a liquid bipropellant system with monomethylhydrazine. Combustion products would include hydrogen chloride and hydrogen fluoride.

- A conventional liquid bipropellant system combining monomethyl hydrazine and nitrogen tetroxide. Combustion products would include carbon dioxide and water vapor.

Of all the combustion products, those containing chlorine, particularly hydrogen chloride, pose the greatest threat to stratospheric ozone. The principal source of hydrogen chloride in rocket exhaust would be ammonium perchlorate, used in solid rocket motors. Chlorine derived from propellants would also be present in rocket exhaust as aluminum chloride, iron chloride, atomic chlorine, and chlorine gas.

Further research for hybrid rockets (typically using one ingredient in liquid form and one as solid) will continue, since most hybrid fuel combinations do not produce either hydrogen chloride or aluminum oxide (AIAA, 1991).

Static test-firings may be conducted during the initial phases of the Preferred Action. During these static firings, most of the effluents are exhausted below a height of 15 kilometers (9.32 miles). The effluents are then washed out rapidly before they can reach the ozone layer. Hence, static firings have a negligible effect on the ozone layer (Harwood et al., 1991).

The infrequency of rocket launches under the Preferred Action would limit the potential impact to stratospheric ozone. While the large Space Shuttle and Titan rockets are not part of the BMDO program, past research suggests that combustion products from these launches do not generally pose a threat to stratospheric ozone levels. For example, based on impact modeling of nine Space Shuttle and six Titan IV launches per year, the following findings were made (SDIO, 1992).

- 15 launches would release an annual total of 0.726 kiloton (726 tons) of chlorine into the stratosphere. This is relatively small compared with the 300 kilotons of chlorine released annually from industrial sources worldwide.

- The corresponding ozone depletion would be less than 0.25 percent over the mid-latitudes and less than 0.1 percent of global stratospheric zone.

- In the immediate vicinity of the Space Shuttle's path (a 100-square-kilometer [38.6-square-mile] area), lateral dispersion would diffuse the chlorine to less than 0.2 percent above the surrounding chlorine levels.

These numbers demonstrate a regionally and globally limited impact on ozone levels from rocket launches.

Furthermore, the 1978 Space Shuttle EIS (NASA, 1978), modeled five different research efforts for a Space Shuttle program with 60 launches a year. The mean global ozone reduction was estimated at 0.25 percent, with a 0.5 percent increase in ultraviolet radiation at the earth's surface. The EIS concluded that the consequences of this increase would be negligible to agriculture, ecology, and climate.

Other exhaust compounds which could lead to ozone destruction either by reacting directly with ozone or by providing a surface for heterogeneous processes include metallic oxide particulates, ice, soot, nitrogen compounds, and hydrogen compounds. None of the studies conducted thus far includes the full complement of compounds emitted by rockets. Particulate

aluminum oxide and nitrogen oxide each have the potential to affect atmospheric chemistry. The role of such heterogeneous chemistry is thought to be central to measured declines in stratospheric ozone. Further research will be needed to better assess future impacts from rocket launches. However, simple steady-state estimates using the NASA launch rate scenario of nine Space Shuttle and six Titan IV launches suggest increases in chemically active stratospheric aerosols of less than 0.1 percent, indicating a negligible long-term global impact (Harwood et al., 1991). Since a 1 percent decrease in global stratospheric ozone is estimated to yield a 1.6 percent increase in annual carcinogenic ultraviolet light and a 2.7 percent increase in non-melanoma skin cancer, then the corresponding health impacts from a 0.1 percent decrease in global stratospheric ozone levels are minimal.

The 1991 *Scientific Assessment of Ozone Depletion* (Harwood et al., 1991) confirms earlier ozone research: within a few kilometers of the exhaust trail of Space Shuttle and Titan IV rockets, local ozone may be reduced by as much as 80 percent at some heights for up to 3 hours. Since the rocket trajectory is slanted, the ozone loss is computed to be reduced over an area of several hundred square kilometers, but the depletion nowhere exceeds 10 percent. All but a fraction of a percent of ozone is predicted to be restored within 24 hours (Harwood et al., 1991).

In the few days following one Space Shuttle launch, stratospheric winds would have stretched and dispersed the exhaust plume to scales greater than 1000 km. The average increase in stratospheric chlorine levels over such an area would be modest, at most +5 percent within a 20° latitude by 20° longitude area. By the end of one month, these perturbations would decrease rapidly to less than 0.2 percent above background levels as the chlorine was mixed laterally throughout the stratosphere (Prather et al., 1990).

Each of the studies quoted above dealt with the largest rocket types in recent use, such as the Space Shuttle and the Titan IV. Rocket launches under the Preferred Action would generally utilize smaller vehicles such as the Minuteman booster or Delta II. Each would emit substantially less chlorine per launch than a Space Shuttle or Titan IV launch. Table 4-1 illustrates that the vehicles planned for use in the BMDO program produce much smaller quantities of effluents when compared to the larger vehicles, such as the Shuttle or Titan IV (The Aerospace Corporation, 1993).

Radiation Balance/Global Climate Change

The principal gases which absorb infrared radiation (and thereby affect the earth's radiation balance) include carbon dioxide, nitrous oxide, water vapor, chlorofluorocarbons (CFCs), and methane. Many of the same substances

that cause stratospheric ozone depletion could also contribute to global climate change.

Both liquid and solid fuel propulsion systems are known to emit water vapor and carbon dioxide. The highest concentration of water vapor in rocket exhaust is produced by propulsion systems that use liquid oxygen and liquid hydrogen. The Shuttle Orbiter's main engine emissions consist of over 95 percent water vapor by weight. Solid propulsion systems emit from 5 to 25 percent water vapor (USASDC, 1992). Hydrocarbon-based fuels that use RP-1 (a kerosene-like liquid fuel used in the Atlas II and Delta II stage one engines) contain an exhaust with up to 70 percent carbon dioxide. Solid rocket motors emit from 25 to 70 percent carbon dioxide when afterburning effects are included (USASDC, 1992). Rocket exhaust emissions of carbon dioxide have been found to be very small compared to quantities emitted into the atmosphere from the burning of fossil fuels (BMDO, 1993). A local increase in carbon dioxide would have only negligible effects in terms of global carbon dioxide concentrations. McDonald et al. (1991) indicate that carbon dioxide emissions by rockets are minuscule: 1×10^{-4} percent of all anthropogenic (human) carbon dioxide and 5×10^{-8} percent of total carbon dioxide production, including natural sources. In another study, which followed the effects of nine Space Shuttle and six Titan launches in 1 year, the amount of carbon dioxide emitted to the atmosphere was 4×10^{-6} percent of all man-made carbon dioxide emissions and 5×10^{-7} percent of total carbon dioxide generation, including natural sources (AIAA, 1991).

In general, EISs in the past have assessed the impacts from propulsion system emissions by comparing them to other man-made pollution sources. Impacts were considered negligible if the quantities of emissions, or the effects on the environment or human health, from system activities were small in the context of other sources (USASDC, 1992).

Based upon conclusions from earlier EISs addressing activities similar to those under the Preferred Action, the impact of NMD activities under the Preferred Action on global climate change would be negligible.

Both NASA and the U.S. Department of Transportation (U.S. DOT), Office of Commercial Space Transportation, consider the impact of rocket exhaust to global climate change to be negligible (as assessed in the Space Shuttle EIS [NASA, 1978]). The basis for this conclusion is that carbon dioxide and water vapor in the exhaust cloud diffuse to background concentrations over a relatively small area (USASDC, 1992). From past research for the Strategic Target System, a schedule of four launches per year would contribute less than 3.6×10^{-9} percent of the total estimated anthropogenic carbon dioxide increase in the atmosphere. It would add less than 2.8×10^{-7} percent of the annual total global carbon dioxide emitted by natural processes (USASDC, 1992).

Testing for the current Preferred Action will emit less carbon dioxide into the atmosphere than a scenario of nine shuttle and six Titan launches per year, since smaller rockets (Delta, Minuteman, and Atlas Class) will be used. Since the emissions of carbon dioxide from the larger rockets is a fraction of the annual carbon dioxide emitted by other processes, the emissions of carbon dioxide from the proposed action are also a fraction of the carbon dioxide emitted by other processes, and the global climate change impact is negligible.

4.2.1.2 Mitigation Measures

Although the potential for adverse impacts to the earth's stratospheric ozone and radiation balance from the Preferred Action is very minimal, there are several opportunities to minimize even minor emissions of harmful compounds. The substitution of Class I and Class II ozone-depleting compounds with safer, alternative compounds is now in progress by DoD and its contractors, earlier than the phaseout dates mandated by EPA regulations. For example, the Air Force Federal Acquisition Regulation Supplement now bans contracts requiring the use of Class I compounds, unless a waiver is granted. While some ODC compounds remain in use, it is possible to minimize the quantities handled and stored and to minimize vaporization through careful handling. More research is necessary into the effects of launches on possible global climate change. A tradeoff may have to be made in substituting ODCs with other compounds which may contribute to global climate change. To further reduce impacts, launch numbers will be minimized by piggybacking test activities for space-based elements on launch missions scheduled for other purposes.

4.2.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.2.2.1 Development and Testing

The types of potential impacts to the upper atmosphere in the development and testing life-cycle phase under this alternative would not generally differ from those described in Section 4.2.1.1 for the Preferred Action. Testing activities, including the number of test launches, may be greater, and the associated potential impacts to the upper atmosphere could increase somewhat.

4.2.2.2 Later Life-Cycle Phases

Production of NMD elements could involve handling some ozone-depleting compounds, as would development and testing activities. The Air Force Federal Acquisition Regulation Supplement is now accelerating the phaseout of Class I ozone-depleting compounds for DoD projects earlier than the EPA-

imposed deadline of 1996. Therefore, alternate compounds with less potential to deplete stratospheric ozone are now phasing in. Some Class II ozone-depleting substances may be used in manufacturing processes until existing supplies are depleted. However, safer substitutions for Class II compounds will also be introduced to DoD projects in advance of the EPA-mandated phaseout for Class II compounds.

For this alternative, there would be an increased frequency of rocket launches to deploy space-based elements. However, the frequency would still not exceed levels known to result in minimal emissions of ozone-destroying and radiation absorbing gases. There could also be some potential for emissions of these gases from decommissioning activities such as destroying rocket motors and burning unused propellant.

4.2.2.3 Mitigation Measures

The mitigation measures described in Section 4.1.1.2 could be applicable to this Alternative.

4.2.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.2.3.1 Development and Testing

The types of potential impacts to the upper atmosphere in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.2.1.1 for the Preferred Action. However, impacts potentially affecting the upper atmosphere balance under this Alternative would be slightly lower due to a decrease in test launches and test firings.

4.2.3.2 Later Life-Cycle Phases

The types of potential impacts to the upper atmosphere in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.2.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, this Alternative would involve increased ground support operations at sensor sites, including aircraft maintenance (engine testing, fuel system maintenance) and static power test of engines. There could therefore be increased use of cleaning solvents, paints, and paint strippers—substances which contain VOCs and absorb radiation in the stratosphere.

4.2.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.2.1.2 could be applicable to this Alternative.

4.2.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.2.4.1 Development and Testing

The types of potential impacts to the upper atmosphere in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.2.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.2.4.2 Later Life-Cycle Phases

The types of potential impacts to the upper atmosphere in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.2.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, this Alternative would involve increased ground support operations at sensor sites, including aircraft maintenance (engine testing, fuel system maintenance) and static power test of engines. There could, therefore, be increased use of cleaning solvents, paints, and paint strippers—substances which contain VOCs and absorb radiation in the stratosphere.

4.2.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.1.1.2 could apply to this Alternative.

4.3 ELECTROMAGNETIC RADIATION

NMD elements under the Preferred Action and System Acquisition Alternatives which could utilize or produce electromagnetic radiation (EMR) include communication systems, electric power lines, ground entry points (GEPs), and radars associated with GBSs. The communications systems and electric power lines would operate in low frequency ranges. The EMR associated with these sources would be similar to that from similar non-military sources and would present no special health or safety concerns. Radars associated with GBSs and GEPs would produce directional EMR with associated frequencies ranging from 8 to 44 gigahertz (GHz). Beams of this type of EMR could pose a safety hazard to people or animals, cause ignition during fueling operations or inadvertent detonation or electroexplosive devices (EEDs), or interfere with the operation of electronic equipment. Although all known EMR hazards associated with NMD activities under the Preferred Action or System Acquisition Alternatives are discussed below, knowledge of EMR hazards continues to grow, and NMD activities could

require modification in the future in response to new findings concerning EMR hazards.

4.3.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.3.1.1 Environmental Consequences

Each of the EMR sources discussed would be present during NMD activities under the Preferred Action. As indicated above, only the EMR generated by GBS radars and by GEPs presents unusual health and safety hazards or hazards to electronic equipment.

Ground-Based Sensors

The final EA for the Ground-Based Radar Family of Strategic and Theater Radars has analyzed potential EMR-related impacts associated with GBSs (USASSDC, 1993b). Design and development of the GBSs are in progress, and performance specifications have not yet been defined. The GBSs are anticipated to operate in the X-band (8 to 12 GHz) at less than 300 kilowatt (kW) average. They are designed to detect and track objects using a pulsed microwave beam. The pulses are fractions of a second with a ratio of average to peak power density of about .25. The GBSs have an aperture of 10 meters (32.5 feet) and would be located approximately 34 meters (113 feet) above ground level. In addition, a mechanical stop would prevent this beam from operating below a 2 degree inclination during normal activities. In the event that a radar beam would be required to go below a 2 degree elevation during testing (e.g., during a splashdown), the radar intensity would be reduced so that the associated power densities would not exceed accepted permissible exposure level (PEL) values. Consequently, a main beam would result in no exposure above the PEL of 5 mW/cm^2 on the ground or ocean surface in the immediate area of a radar (USASSDC, 1993b).

The far-field power density in the grating lobes of GBSs would vary with positions and operating variables (such as the angle of beam and the operating power) but would not normally exceed 0.8 percent of the main beam at the same distance. Grating lobes of primary concern would occur at main beam angles between 31 and 46 degrees. At these angles, the grating lobes would be directed toward the ground (USASSDC, 1993b).

Safe operation of the GBSs is an important criterion associated with the design of the system. Three specific criteria have been defined to ensure that operation of a GBS does not result in harmful exposure of individuals in

the vicinity. Microwave power densities from GBSs would not exceed the following (USASSDC, 1993a):

- 5 mW/cm^2 averaged over any 6-minute period on the ground or on any existing structure within 2 kilometers (1.25 miles) of a radar.

- 1 mW/cm^2 averaged over any 6-minute period on the ground or on any existing structures at distances greater than 2 kilometers (1.25 miles) from the radar.

- 50 mW/cm^2 averaged over any 1-second period on the ground or on any existing structure.

These exposure levels are more stringent than those permitted in the latest recommendations for human exposure issued by the Institute of Electrical and Electronics Engineers (IEEE) and accepted by the American National Standards Institute (ANSI) (IEEE C95.1 - 1991) for exposures in uncontrolled environments (see Section 3.3.2).

Computer controls in the main data processor would ensure that EMR power densities would be in accordance with the above criteria. Simulations would be used to verify the accuracy of the controls.

Human exposure to EMR would be maintained at acceptable levels by the GBS design and operation parameters. Although EMR levels would be less than the established PEL limits, there is a possibility that EMR could affect the operation of some models of cardiac pacemakers. It would be necessary to include a standoff zone from each GBS marked clearly with signs warning of the danger to cardiac pacemakers; develop an administrative procedure to inform all travelers of the presence of EMR fields near the GBS; and identify all residents near the GBS who wear pacemakers to inform them of potential EMR fields.

If environmental exposures are kept under those values given in human exposure standards, most animal species should not be adversely affected, since human exposure standards were obtained by experimentation with animals. This would generally be true for animals in ground-level areas around the radars but would not necessarily be true for birds in flight.

Although there is little information on the biological effects of EMR on birds, the thermal effects of EMR on birds is a matter of concern, considering the possible power densities associated with the GBS. However, the probability of substantial harm to birds appears to be low. Near the radar, where the power density is the greatest, the beams would be relatively small. For a bird to remain in the beam for an extended period, it would have to either fly directly toward the radar along the beam trajectory path or hover for an extended time in the beam. In normal operations, the beam would be

constantly moving, further reducing the probability that a bird would remain in the beam for an extended period.

Potential hazards from fuel ignition and inadvertent detonation of EEDs and ordnance would be evaluated by calculating the potential EMR levels of locations involved and comparing the EMR levels with applicable safety criteria. EMR measurements would be taken at selected sites before initiating activities involving fueling or EEDs. Operational constraints would be imposed as necessary to eliminate potential hazards.

Exposure to the main beam could affect the electronic communication equipment and EEDs aboard commercial and military aircraft crossing the main beam. Flight restrictions in the radar area and coordination with the U.S. Federal Aviation Administration (FAA) would be necessary (USASSDC, 1993a).

Ground Entry Points

GEP transmitters would operate at 44 GHz (uplink) and 20 GHz (downlink), with a typical power of approximately 200 watts. The transmitter would be connected to an 8-foot parabolic dish to provide a focused narrow beam.

An analysis of potential electromagnetic interference was completed in 1993 by the Electromagnetic Capability Analysis Center. This analysis determined that a separation distance of at least 11 meters (36 feet) is required between the GEP transmitter antenna and any communications equipment to avoid potential high-power interference interactions, and no separation distance is required between the GEP antenna and personnel in order to meet EMR exposure standards with the exception of GEPs used to support SBSs. GEPs supporting SBSs may require a personnel standoff distance of 5 meters (16 feet). Operation of the GEP would be compatible with radars as long as operations are coordinated. The GEP would have to be located at least 450 meters (1475 feet) from any EEDs that could be radiated by the main beam (Rogers, 1993).

4.3.1.2 Mitigation Measures

The power densities of the EMR from NMD activities would be controlled to ensure compliance with accepted safety standards. Standoff distances for personnel and electronics equipment would be implemented as necessary. Depending on the test sites, coordination with the FAA could be necessary to mitigate impacts to avionic equipment. It could also be necessary, depending on site locations, to coordinate with the U.S. Fish and Wildlife Service (U.S. FWS) to identify and mitigate potential impacts to birds and other wildlife.

4.3.2 GROUND AND SPACE-BASED SENSORS AND GROUND- AND SPACE- BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.3.2.1 Development and Testing

Potential impacts from EMR in the development and testing life-cycle phase under the Ground- and Space-based Sensors and Ground- and Space- Based Interceptors Alternative would not generally differ from those described in Section 4.3.1.1 for the Preferred Action.

4.3.2.2 Later Life-Cycle Phases

Production activities would include fabrication, assembly, and routine component integration testing of operational radar systems. Production would take place in contractor facilities equipped for electronic component production. Extensive EMR use outside of contractor facilities would not occur during the production phase. EMR use during production would be limited to EMR with low frequencies.

Basing NMD components under this Alternative would involve EMR impacts from GBSs and GEPs similar to those described for the Preferred Action. Impacts from EMR could be somewhat greater due to more extensive use of GBSs and GEPs. The GBS and GEP systems would be shut down prior to decommissioning. EMR generation during decommissioning would be limited to EMR with low frequencies.

4.3.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.3.1.2 could be applicable to this Alternative.

4.3.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.3.3.1 Development and Testing

Potential impacts due to EMR in the development and testing life-cycle phase under the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.3.1.1 for the Preferred Action.

4.3.3.2 Later Life-Cycle Phases

Potential impacts due to EMR in the production, basing, and decommissioning phases under the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.3.2.2 for the Ground- and Space-Based Sensors and Ground- and

Space-Based Interceptors Alternative. There would be a greater number of GBSs under this Alternative. All GEPs under this Alternative would transmit only in short bursts and would, therefore, not require personnel hazard areas.

4.3.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.3.1.2 could be applicable to this Alternative. GEPS would not require personnel hazard areas under this Alternative.

4.3.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.3.4.1 Development and Testing

Potential impacts due to EMR in the Development and Testing Life-Cycle phase under this Alternative would not generally differ from those described in Section 4.3.1.1 for the Preferred Action.

4.3.4.2 Later Life-Cycle Phases

Potential impacts due to EMR in the production, basing, and decommissioning phases under this Alternative would not generally differ from those described in Section 4.3.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.3.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.3.1.2 could be applicable to this Alternative.

4.4 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

The potential for contamination of air, water, soil, or other environmental media by hazardous materials and waste management activities under the Preferred Action or System Acquisition Alternatives could be effectively reduced through properly implemented mitigation measures, including but not limited to a comprehensive pollution prevention program. All anticipated releases of hazardous materials or waste to these environmental media would be within federal standards established under the regulations discussed in Appendix G. Any exposure of workers to hazardous materials and wastes would comply with Occupational Safety and Health Act (OSHA) regulations. Disposal of hazardous waste would be conducted in accordance with all applicable regulations. Localized or widespread environmental contamination could result from an accidental release of

hazardous substances or wastes. For example, a launch vehicle could have an accident during a flight test and release hazardous substances. However, available mitigation actions could reduce the likelihood of these events.

4.4.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.4.1.1 Environmental Consequences

The greatest potential for environmental impacts from hazardous materials used by, and hazardous waste generated by, NMD activities under the Preferred Action would be from accidental spills or leaks. Some activities would unavoidably release very small quantities of hazardous materials to the environment. These cumulatively minimal releases would be well below all applicable regulatory thresholds.

Activities under the Preferred Action could involve the use and disposal of small quantities of the following types of hazardous materials:

- Toxic and flammable solvents
- Reactive solid rocket propellants
- Toxic, corrosive, and reactive liquid rocket fuel
- Oxidizers
- Toxic and carcinogenic compounds, including heavy metals and heavy metal compounds
- Toxic metal batteries
- Corrosive and flammable etchants
- Vehicle operation and maintenance fuels and oils
- Pesticides

These hazardous materials (and items containing them) could be transported between established production and distribution facilities in the commercial sector, assembly and fabrication facilities, and/or testing facilities. Anticipated releases of hazardous materials to the environment occurring during transportation would be minimal. Although accidental releases of hazardous materials during transport between facilities could be possible, these materials would be transported according to applicable U.S. DOT regulations, thereby minimizing the probability of accidental release.

Very small quantities of some hazardous materials could be routinely released to the environment through evaporation and direct discharge. Releases from solvent evaporation, rocket fuel burning, and test launch debris would be unavoidable but would occur in a manner that complies with applicable regulatory standards and incorporates the appropriate mitigation measures identified in Section 4.4.1.2. These releases could originate from laboratories and fabrication areas as well as from flight tests. Accidental releases of these materials also are possible, but would not be likely. Accidental releases of other materials, especially liquids, would be possible. Liquids such as rocket fuel, etchants, vehicle operation and maintenance liquids, and pesticides would be susceptible to accidental release.

Air emissions resulting from solvent evaporation and burning rocket fuel (from launches and decommissioning) are air emissions that are regulated under the CAAA. These releases would be within regulatory limits, as discussed in Section 4.1.1.1.

The potential impacts from releases through test launch debris could also be substantial. Terminated test vehicles containing hazardous materials could distribute the hazardous materials over a large area, resulting in widespread contamination of the surface soil in a test range. Depending upon the location of an accidental spill, localized contamination of soil, groundwater, and surface water could result. Regulatory compliance measures such as the implementation of Spill Prevention Control and Countermeasures (SPCC) plans and contingency plans would reduce accidental releases and limit the impact of any releases that do occur. Additional mitigation measures are outlined in Section 4.4.1.2.

Hazardous wastes requiring disposal could be generated by some activities, such as cleaning or etching electrical and mechanical components. Test launches of GBIs or GBI targets, or launches of rockets carrying space-based elements for tests, could generate unburned propellants and other fuels. The quantities of these materials could be minimized by applying the appropriate mitigation measures identified in Section 4.4.1.2. Materials such as damaged or defective components containing hazardous materials would have to be disassembled, recycled, or disposed. Only approved facilities meeting applicable regulatory requirements could accept these materials for disposal. No unavoidable routine releases of hazardous wastes would result from the transport of these wastes to either recycling, treatment, or disposal facilities. However, accidental releases could be possible. Small routine releases of certain hazardous waste from recycling, treatment, and disposal facilities would be unavoidable, but would be in compliance with applicable regulations.

4.4.1.2 Mitigation Measures

Several mitigation measures could be taken to reduce potential impacts from the use of hazardous material and the generation of hazardous waste. All mitigation measures required by applicable federal, state, and local regulations would be implemented, including the following:

- Waste minimization programs meeting the spirit and intent of Executive Order 12856 and compliance with the requirements of right-to-know and pollution prevention laws and regulations.
- Emergency response and cleanup measures to remediate environmental contamination in the event of an accidental release, including implementation of SPCC plans and notification of all appropriate natural resource agencies including the U.S. Department of the Interior.
- Installation of air pollution control devices where required to control releases to the air.
- Installation of wastewater treatment devices where required to treat discharges to the water.
- Requirement that contractors prepare and implement Pollution Prevention Implementation Plans.
- Hazardous materials used in missiles/boosters will be designed to reduce releases of materials.

Other mitigation measures that could be performed wherever appropriate include the following:

- Recovery of flight test vehicles and debris containing hazardous materials could be recovered as soon as possible following tests.
- Storage of certain hazardous materials in areas with secondary containment to contain potential leaks.
- Minimizing usage of hazardous materials to the extent practicable. Hazardous materials used in missiles/boosters will be designed to reduce releases of materials.
- Implementation of pollution control devices and practices where practicable to reduce releases to air and water.
- Treatment of or recycling on-site of hazardous wastes, wherever feasible and allowed by regulations.

- Transport of hazardous wastes to approved off-site recycling, treatment, and disposal facilities.

- Use of storage facilities to adequately protect hazardous material containers in areas where weather can degrade the integrity of hazardous material containers.

4.4.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.4.2.1 Development and Testing

The types of hazardous materials and hazardous waste impacts in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section 4.4.1.1 for the Preferred Action. However, somewhat greater amounts of hazardous materials and/or hazardous waste could be present at certain installations. The same pollution prevention and environmental protection practices discussed for the Preferred Action could effectively minimize the potential for contamination of environmental media.

4.4.2.2 Later Life-Cycle Phases

The same types of hazardous materials used in, and hazardous wastes generated by, fabrication of NMD elements for testing would be involved in fabrication of these elements in the later life-cycle phases. The rate of solvent usage and generation of spent solvents could temporarily rise at times during the production phase. There would also be a potential for accidental spills or leaks of hazardous materials during transportation between installations and facilities during the production phase.

Deploying space-based elements could also require the use of hazardous materials and the generation of hazardous wastes. These hazardous materials could include solid rocket fuels and associated oxidizers used in launch vehicles. Hazardous wastes could include solid rocket fuel from damaged or off-specification launch vehicles. All hazardous materials and hazardous wastes would be managed in accordance with applicable regulations.

Construction activities during the basing, systems maintenance, and support operations phase (including refurbishment or demolition of existing facilities to accommodate new facilities) could use a variety of hazardous materials and generate a variety of hazardous wastes. These hazardous materials could include explosives (especially if demolition work were required) and fuels for equipment and vehicle operation. Substantial routine releases of

hazardous materials to the environment would not be likely. These materials would be managed in accordance with applicable regulations.

Hazardous wastes generated during the basing systems maintenance and support operations phase could include used solvents and oils from equipment and vehicle maintenance, petroleum sludges from underground fuel tank closure, and asbestos and lead solder from demolition. Accidents that result in hazardous materials release would be possible. Hazardous materials released by accidents could result in fuel- or oil-contaminated soils and groundwater. Clean-up of such materials would result in the generation of hazardous wastes. These wastes would be managed in accordance with applicable regulations.

The types of hazardous materials used and hazardous wastes generated during the decommissioning phase would differ from those discussed for the development and testing phase. Usage of hazardous materials during disassembly and destruction of items would be minimal.

Many items fabricated during the NMD Program could have no potential for reuse and therefore require disposal. Some items such as radars could be reused outside the NMD Program and not therefore require disposal. Certain of these items, such as hazardous rocket propellants, electronics, and sensor materials, could require reclamation prior to reuse, and could therefore be regulated as hazardous waste even though they could be reused. All feasible efforts would be made to recycle and reclaim valuable items and materials during decommissioning. However, the value of some items could be offset by the required reclamation and handling costs. Accidental releases of liquid hazardous wastes during decommissioning would be possible but not likely and would be comparable to those released during the development and testing phase.

4.4.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.4.1.2 could also be applicable to this Alternative.

4.4.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.4.3.1 Development and Testing

The types of potential impacts related to hazardous materials and waste management in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.4.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. As for that Alternative, the greatest potential for environmental impacts from hazardous materials and hazardous wastes would be from

accidental spills or leaks. There would likewise be unavoidable releases of very small quantities of hazardous materials to the environment, but the effects would be minimal. The quantities of hazardous materials and wastes used, generated, and released to the environment would be roughly comparable.

4.4.3.2 Later Life-Cycle Phases

The types of potential impacts related to hazardous materials and waste management in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.4.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors Alternative. However, because there would be fewer launches, there would be less potential for launch-related releases of hazardous materials.

4.4.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.4.1.2 could be applicable to this Alternative.

4.4.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.4.4.1 Development and Testing

The types of potential impacts related to hazardous materials and waste management in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.4.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. The quantities of hazardous materials and hazardous wastes used, generated, and released to the environment under this Alternative would be roughly comparable to the other Alternatives and is slightly greater than the Preferred Action.

4.4.4.2 Later Life-Cycle Phases

The types of potential impacts related to hazardous materials and waste management in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.4.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, the overall magnitude of potential impacts could vary, depending on the quantity of material or waste involved.

4.4.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.4.1.2 could be applicable to this Alternative.

4.5 NOISE

Brief, intermittent periods of noise could be generated by rocket launches, GBI test firings, and engine testing activities under the Preferred Action or the System Acquisition Alternatives. Measures to protect occupational workers from unsafe noise levels would be necessary to comply with OSHA and DoD regulations. Nearby residents and terrestrial wildlife could be disturbed by these noise events. Mitigation measures to reduce the intensity or adjust the timing of certain noise events could be necessary to reduce noise disturbances to residents. Under the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives, most noise events would originate from existing government installations or contractor facilities with a history of similar noise generation.

4.5.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.5.1.1 Environmental Consequences

The greatest potential for noise from NMD activities under the Preferred Action would be from infrequent rocket launches, test firing of GBIs, sonic booms, and sled testing of components. Additional sources could include diesel generators, heating, ventilation, and air conditioning systems, cooling systems, and ground support equipment. Rocket launches would likely result in sound pressure levels in the range of 80 to 145 decibels A-weighted (dBA) at 305 meters (1,000 feet) from the launch site. Noise levels generated by other noise sources would be less than those generated by rocket launches.

OSHA noise exposure standards for workers limit the maximum noise level for a period of 15 minutes or less to 115 dBA. The maximum impulsive noise is limited to 140 dB peak (29 CFR 1910.95). Noise from launches at existing government facilities would be similar to noise from ongoing programs at those facilities, but the frequency of noise events could temporarily increase.

Noise from rocket launches could also impact residents and wildlife living close to the launch facilities. However, launches would generally be conducted in remote areas or at facilities with a history of rocket launches. Launches would generate noise levels similar to previous launches at the facilities.

Sonic booms are generated by the movement of objects at speeds greater than the speed of sound. NMD activities under the Preferred Action which could generate sonic booms include rocket launches and the flight of test missiles. The boom would occur along the flight path. The sound levels on the ground from a sonic boom would depend on the flight profile of the object, the design of the object, and atmospheric conditions. Potentially adverse impacts from sonic booms could include the startling of people and animals, the annoyance of people, and possible effects on structures (e.g., cracked walls or broken windows). The incidence of sonic booms would not be expected to be great, due to the limited frequency of these activities under the Preferred Action. The impact at any one location would be of short duration.

Brief, low levels of construction noise could be generated by limited activities to expand or build testing facilities. These levels would be typical of other construction noise and would not likely be noticeable except by residents living immediately adjacent to the facilities, for whom the potential for short-term noise disturbance would be greater.

4.5.1.2 Mitigation Measures

Mitigation of noise from NMD rocket launches and test firing could involve various measures currently employed to mitigate noise levels at test sites and launch sites. Noise from static firing of rocket motors could be reduced by providing noise barriers around test sites, conducting tests under favorable meteorological conditions, and providing adequate buffer zones around test sites. Noise impacts from rocket launches could be reduced by minimizing rocket launches at night, conducting launches under favorable meteorological conditions, selecting flight tracks that minimize the exposure of underlying communities to sonic booms, providing adequate buffer zones around launch sites, evacuating personnel to a safe distance from the launch site (or providing concrete bunkers with sufficient noise attenuation for personnel who must remain in the launch area), and providing roadblocks to limit access by the public to areas with potentially high noise exposures.

The use of deluge water when launching larger rockets (such as those to carry space-based elements into orbit) could provide acoustic damping at the launch site (SDIO, 1992). Deluge water is discussed further in Section 4.7.1.1.

Worker exposure to noise would be minimized by complying with OSHA requirements and DoD standards for worker noise exposure. These requirements include the use of engineering measures to minimize noise levels and the provision of hearing protection for workers in high noise areas.

Mitigation of noise from other sources such as motors, generators, and cooling systems could be accomplished by use of standard silencing packages provided by the manufacturer and proper maintenance of the equipment.

4.5.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.5.2.1 Development and Testing

The types of potential noise impacts described in the development and testing life-cycle phase under this Alternative would not generally differ from those described in Section 4.5.1.1 for the Preferred Action. As for the Preferred Action, the greatest potential for noise would be from launches, static firing of rocket engines and sonic booms. The frequency of noise events could be somewhat greater for this Alternative than for the Preferred Action since more launches would take place.

4.5.2.2 Later Life-Cycle Phases

Production of rockets, sensors, electronic equipment, and other NMD elements would occur mostly at existing government or contractor facilities and result in noise levels similar to current levels at those facilities. Some construction noise could be generated where facilities must be modified or expanded or where new production facilities must be constructed. Actual noise impacts would depend on the setting, including proximity to noise-sensitive areas and the types of noise sources. Some increased noise levels could be generated by increased traffic resulting from increased employment at production facilities. These noise impacts would be addressed as necessary in future environmental documentation.

Deployment of space-based elements would result in noise impacts from rocket launches to deploy space-based hardware. These launches are expected to use existing launch sites and infrastructure. Launch vehicles could include Atlas, Delta, or Titan rockets.

Construction noise impacts from basing would not likely be intrusive to surrounding communities, since the major facilities would be expected to be constructed at sufficient distance from residential areas to minimize noise impacts. Construction at antenna sites and of fiber-optic cable lines could result in some short-term noise impacts to nearby receptors.

Noise from periodic firing of rockets at government or contractor facilities in the production and basing, systems maintenance, and support operations phases would be similar to that during the development and testing phase.

The noise from static testing of rocket motors would be of greater duration (30–120 seconds) than that from rocket launches.

Increased traffic noise could also result from increased employment at basing sites. Other noise sources associated with these systems, such as power sources and heating, ventilation, and air conditioning systems, would not likely result in noise impacts in the surrounding community. These impacts would be addressed as necessary in future environmental documentation.

Rocket disposal during decommissioning of NMD facilities would be accomplished by static firing, burning of propellant, or washout of propellant. Static firing would have the greatest potential for noise impacts and would result in short-term noise impacts (30–120 seconds) similar to those described for rocket testing in Section 4.5.1.1. If explosives had to be used for destruction of silos, a noticeable increase in noise levels could be experienced by surrounding communities for short periods. These noise levels could have the potential to cause structural damage from ground vibration and other noise-induced vibration. Some short-term increases in traffic noise could also result from transport of weapon system components.

4.5.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.5.1.2 could be applicable to this Alternative. If explosives had to be used for demolition during decommissioning, noise from the use of explosives could be minimized by following government specifications for explosive demolition, preparing demolition plans which identify sensitive areas, minimizing the amount of explosives used, using blast mats, and limiting the use of explosives to times of favorable meteorological conditions.

4.5.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.5.3.1 Development and Testing

The types of potential noise impacts in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.5.1.1 for the Preferred Action. The frequency of noise events could be somewhat less for this Alternative than for the Preferred Action since space-based element hardware would not be tested.

4.5.3.2 Later Life-Cycle Phases

The types of potential noise impacts in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.5.2.2 for the Ground- and Space-Based

Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. There could be less noise created by launching activities; but noise would be generated at a greater number of sites on the ground, potentially affecting more noise-sensitive receptors.

4.5.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.5.1.2 could be applicable to this Alternative.

4.5.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.5.4.1 Development and Testing

The types of potential noise impacts in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.5.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative and would be slightly greater than the Preferred Action.

4.5.4.2 Later Life-Cycle Phases

The types of potential noise impacts in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.5.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. There could be less noise created by launching activities; but noise would be generated at a greater number of sites on the ground, potentially affecting more noise-sensitive receptors.

4.5.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.5.1.2 could be applicable to this Alternative.

4.6 SAFETY

Occupational workers involved with NMD activities under the Preferred Action or the System Acquisition Alternatives would be exposed to a number of toxic, explosive, or otherwise hazardous materials and dangerous physical agents. Examples of hazardous materials associated with NMD activities include propellants, solvents, and explosives; and examples of dangerous physical agents associated with NMD activities include EMR (discussed further in Section 4.3) and noise (discussed further in Section 4.5). Most NMD activities would be performed within government installation and contractor facility fences, where they would present no

safety hazard to the public. Since little new construction would be required and normal safety practices would be followed, construction-related accidents would not represent a greater than normal safety risk to workers. A few activities, such as rocket launches and interceptor test firings, could pose a minimal public safety hazard.

4.6.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.6.1.1 Environmental Consequences

Research supporting the development of NMD elements could involve processes, procedures, and materials, that could be potentially hazardous to workers. But because relatively small quantities of hazardous materials would be handled in the laboratories, the potential for substantial releases to the environment and endangerment to the public would be minimal. Experience obtained from this initial research would reduce the risks associated with these same materials and processes during subsequent development activities. However, there could still be a potential for safety hazards to arise during later development efforts. The integration of development processes could create synergistic hazards. But because of the expected small quantities of hazardous materials and the controlled conditions under which they are used, any potential accident would not be expected to impact personnel or the environment outside the boundaries of the facility.

Subsequent testing activities would involve a relatively greater safety risk than would research and development. As more and more subassemblies became integrated, there would be a greater potential for increased toxic, explosive, and other hazardous effects. Larger quantities of hazardous materials would be used, and there would be a greater potential for spills or other releases of these materials to the environment, possibly endangering the public. Radioactive material used in hardness testing would not pose a significant safety threat. The hazards associated with x-ray machines, particle accelerators, and nuclear reactors are well understood. Appropriate facility safety programs and plans could effectively reduce these risks.

Lasers may be used during research and testing activities. Lasers can cause severe eye damage to unprotected personnel within the Nominal Ocular Hazard Distance (NOHD). The NOHD, an ANSI standard, is the distance along the axis of the beam beyond which exposure to the human eye would not exceed allowable exposure limits to prevent eye damage. Optical protection or mechanical barriers (e.g., building walls) could be used to reduce exposure (BMDO, 1993).

Ground-Based Interceptors

Development and testing of missile systems is a common practice in the United States and the potential hazards are well understood. Component and subassembly manufacture of missiles could involve exotic metals and alloy components (such as beryllium and mercury alloys), carbon composites, various semiconductors (such as gallium arsenide), and other high-technology materials. As discussed in Appendix I, many of these substances can be safety hazards. The handling of these materials could pose a risk to occupational workers unless adequate health and safety measures are employed.

Potential hazards from the GBI boost vehicle (BV) propulsion systems used in test launches would be dependent upon the type of propellant used. Liquid and gel propellants would be produced separately from the fuel oxidizers necessary for combustion. Because the fuel oxidizers would not be added until immediately prior to firing, the chance of an accident prior to firing would be minimal. With solid propellants, however, it would be necessary to incorporate the oxidizers during the manufacturing process, increasing the potential for an accident.

Handling and transport of GBI test components over public roads would pose a risk to the public from explosion and secondary effects, such as fire or toxic vapor clouds. Solid propellants can ignite while in transit due to heat, friction, or impact. If ignited, propellant would probably burn until fully consumed, since water and other conventional fire-fighting methods are relatively ineffective. Burning propellant would emit combustion products, such as hydrogen chloride gas. This gas can produce mild to severe irritation of the eyes, lungs, and nasal passages and can also burn the skin and cause dermatitis.

Workers could be at risk from spills during GBI liquid fueling activities. But because fueling areas would not be accessible to the public, there would be little risk to the public. Liquid fuel propellants such as hydrazine, unsymmetrical dimethylhydrazine, and monomethylhydrazine are highly toxic and can be readily absorbed through the skin or through the inhalation of vapors. Hydrazines attack the liver in humans and are suspected carcinogens. Because hydrazines can react strongly in the presence of oxidizers, hydrazine propellants would be stored in stainless steel containers to prevent leaks. The oxidizers that would be used with the hydrazines are also highly toxic and can sustain a fire without the presence of oxygen. The oxidizers are also an extreme inhalation hazard, forming burning acids in the lungs; contact with the skin can produce acid burns.

When GBIs are fired, propellant combustion products would produce toxic air pollutants which then could drift downwind onto adjoining lands. Successful test firings would generate debris from the destruction and

decomposition of both GBI and target vehicle debris. Some of this debris could include hazardous materials. Unsuccessful tests could create launch area explosions, fire, and debris. Early flight anomalies could cause the transmittal of a destruct command, creating explosions and debris. But these hazards would likely still be contained within installation or facility fences, away from the public.

Ground-Based Sensors and Ground Entry Points

As discussed in Section 4.3.1.1, GBS would generate directional high frequency EMR with the potential to injure humans. Although the main beam would be aimed skyward, and thus pose no risk to persons on the ground, occupational workers in the immediate vicinity of areas where GBSs are being tested could inadvertently enter the sidelobes or grating lobes (discussed in Section 3.3). In addition, some precautions should be taken to minimize GEP effects, although the magnitude of those effects is far less than those found in the same category as GBS. The GEP EMR effects are associated with GEP main beam, not sidelobes.

Space-Based Elements

Rocket launches would be necessary to carry space-based elements into orbit. Many of the hazards associated with the handling and combustion of propellants for GBIs would also apply to the propellants used for these larger rockets.

4.6.1.2 Mitigation Measures

Each government installation and contractor facility would implement a comprehensive safety plan to address potential and known hazards involved with each activity. The plans would draw extensively from past experience to reduce the potential for any accident. Examples of possible mitigation measures are summarized below.

- Approved safety and health programs established, implemented, and maintained at each NMD Program activity would serve to protect personnel from accidents and injury.

- Well-researched and thoroughly documented procedures would form the foundation for safe and efficient operations. Accurate, detailed procedures with emphasis on safety would form the basis for a strong personnel training program.

- Thorough training, qualification, and where appropriate, certification of personnel would reduce risks to occupational workers and the general public.

- Strong public awareness and community relations programs could be of considerable assistance by ensuring that the public is informed of program activities which could adversely affect them. These programs could allow the public to have a voice in program activities which could affect their localities.

- Safety and handling regulations for explosives would be scrupulously followed. Explosive Safety Quantity Distance arcs could be established with strict regulations for entry.

- Applicable transportation regulations concerning the movement of explosive and hazardous materials by road, rail, sea, or air would be followed.

- Onsite waste minimization plans could be implemented. Where feasible, offsite recycling of hazardous materials could be accomplished.

- Where engineering controls are not feasible, the appropriate level of personal protective equipment would be used to protect workers from both the short-term and long-term effects of potentially hazardous materials.

- All launches associated with technology readiness program activities would be subject to launch approval and range safety procedures established for every test range being considered. Range safety operations in support of launches are intended to minimize the potential for hazards to onsite workers and the offsite public associated with both normal launches and launch/aborts.

4.6.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.6.2.1 Development and Testing

Potential safety hazards in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section 4.6.1.1 for the Preferred Action. However, the risk of program-related accidents could be somewhat greater because of the increased scale of NMD activities under this Alternative.

4.6.2.2 Later Life-Cycle Phases

The potential for safety hazards would increase from that in the development and testing phase because of the larger scale of activity and the larger number of workers involved. Although the hazards of NMD element fabrication processes would be better understood, the potential for

errors would be increased due to the larger number of workers involved. Any errors that do occur could result in injuries to more people. There would also be a greater chance for a sympathetic explosive reaction in a full-scale manufacturing facility.

As addressed in Appendix I, workers in the production and basing of NMD elements would be exposed to a number of toxic, explosive, or otherwise hazardous materials, some of which may be new. Many are the same materials encountered in the development and testing life-cycle phase, except that larger numbers of workers could be exposed to greater quantities of the materials.

The dispersed basing locations for ground-based elements would require transportation of substantial quantities of materials, components, and equipment by road, rail, water, or air. Some of these materials could be hazardous, requiring precautions to protect workers and the public in communities along transportation routes. Explosive and hazardous materials similar to those used in the NMD Program are routinely transported in a safe manner.

Following basing, appropriate safety precautions would be necessary when working around GBIs to prevent accidents such as fires, explosions, or release of toxic fumes. The potential for accidents would be greatest when the GBIs or GBI components, such as the KV, are undergoing testing or are being serviced. Strict quality control measures would be necessary whenever such tests or servicing operations are performed.

Operation of the radars comprising GBSs would generate EMR, as discussed for the test radars in the development and testing stage. Ground personnel could be injured if exposed to EMR beams. Careful marking and exclusion of personnel from areas close to the main beam or sidelobes would be necessary, as would careful regulation of the beam power density. Careful planning would be necessary to ensure that EMR beams from radars do not interfere with other electronic equipment collocated on the same installation.

Once in space, space-based elements would pose little or no safety hazards. Although SBIs, like GBIs, would be subject to accidental explosion, it is unlikely that people would be in space to experience the impact. An SBI explosion would create orbital debris, which is discussed further in Appendix H.

Decommissioning ground-based elements could generate considerable quantities of hazardous materials such as propellants, coolants, battery system fluids, and other materials that are explosive or toxic. These materials would be promptly recycled or disposed of as waste in RCRA-approved locations. Destruction of some ground-based structures could require the use of explosives, requiring the usual precautions to protect

workers. Space-based elements would likely be decommissioned by "parking" in safe orbits for possible future reuse.

4.6.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.6.1.2 could be applicable to this Alternative.

4.6.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.6.3.1 Development and Testing

The types of potential safety hazards in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.6.1.1 for the Preferred Action. However, the risk of program-related accidents could be somewhat less because of the decreased scale of NMD activities under this Alternative.

4.6.3.2 Later Life-Cycle Phases

The types of potential safety hazards in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described for ground-based elements in Section 4.6.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. Because of the possible requirement for additional GBSs and/or GBIs under this Alternative, the possibility could exist of slight additional risk of exposure for workers and the public from the associated siting and operational hazards.

4.6.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.6.1.2 could be applicable for this Alternative.

4.6.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.6.4.1 Development and Testing

The types of potential safety hazards in the life-cycle phase of this Alternative would not generally differ from those described in Section 4.6.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative and would be slightly greater than the Preferred Action.

4.6.4.2 Later Life-Cycle Phases

The types of potential safety hazards in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.6.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.6.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.6.1.2 could be applicable to this Alternative.

4.7 SURFACE WATER

Although surface waters within, or close to, installations used by NMD activities under the Preferred Action or the System Acquisition Alternatives would be subject to inadvertent contamination by stormwater runoff, sedimentation, or spills or leaks of hazardous liquids, the risk could be effectively reduced through mitigation measures. These include adherence to stormwater management plans, soil erosion and sediment control plans, and SPCC plans, including best management practices for handling hazardous liquids. Surface waters near facilities used for static fire tests or for launching rockets or interceptors would be subject to contamination by exhaust clouds. Surface waters under missile or rocket trajectories would be subject to contamination by falling solid debris. Surface waters near rocket launch pads used in connection with space-based elements would be subject to contamination by runoff of deluge water. However, the infrequency of these activities, coupled with the availability of effective mitigation measures, limits the potential for these impacts.

Most government installations and contractor facilities accommodating NMD activities would not directly withdraw surface water to meet water demands, although some could be supplied by municipal water systems fed by surface water. If necessary, the small quantities of water (Section 4.8) necessary to support most NMD activities could be withdrawn from most large rivers, lakes, or reservoirs with no adverse hydrological or ecological impacts. Although some NMD activities could take place at existing facilities within floodplains (especially coastal test facilities within areas subject to coastal flooding), new construction within floodplains, especially inland (riverine) floodplains, would be unlikely.

4.7.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.7.1.1 Environmental Consequences

Surface Water Quality

Streams, lakes, and nearshore coastal waters near facilities used to conduct NMD activities under the Preferred Action would be subject to the usual sources of inadvertent contamination associated with industrial facilities. These sources include stormwater runoff, sediment originating from areas of exposed soils, and spills or leaks of industrial chemicals such as fuels and propellants. The risk of contamination from these sources could be effectively reduced through mitigation measures such as adherence to stormwater management plans, soil erosion and sediment control plans, and SPCC plans, including best management practices for handling hazardous liquids. Each is discussed further in Section 4.7.1.2.

There are some potential sources of inadvertent surface water contamination unique to activities involving test-firing interceptors or launching rockets. For example, exhaust clouds generated by test-firing events or rocket launches typically contain hydrogen chloride and aluminum oxide, substances capable of entering and acidifying surface water (BMDO, 1993). However, studies of exhaust clouds generated by Space Shuttle and Titan IV rocket launches suggest that any surface water acidification is localized and temporary (USAF, 1988; NASA, 1978). Hydrogen chloride deposition from Space Shuttle exhaust clouds has been shown to affect surface water within only 285 meters (930 feet) of the launch complex (BMDO, 1993). Test-firing and rocket-launching activities would be infrequent under the Preferred Action, and the exhaust clouds generated by test-firing interceptors and launching the Delta II rockets likely to be used in testing space-based elements would be smaller than those generated by the Space Shuttle or Titan IV rocket.

Additionally, surface waters underlying interceptor or rocket trajectories would be subject to falling solid debris, which could contaminate receiving waters through corrosion or through leakage or dissolution of unburned propellants. However, most test-firings or launches would occur over the desert or ocean. The ocean is not as sensitive to minor sources of contamination as inland waters. Metallic fragments are thought to corrode and release metal ions to water at a very slow rate relative to the ocean's mixing rate (NASA, 1972). Solid propellants are also thought to dissolve too slowly, and liquid propellants are thought to become diluted too rapidly, in the ocean to result in even localized contamination (USASDC, 1992). In contrast, localized contamination could result if solid debris fell into nearshore coastal waters or inland waters and were not immediately retrieved.

Another potential source of inadvertent surface water contamination would be runoff of spent deluge water used to reduce noise and heat generated during rocket launches (for example, 1,059,915 liters [280,000 gallons] for an Atlas II launch and 640,000 liters [170,000 gallons] for a Titan IV launch). Deluge water is not necessary to launch sounding rockets and targets. Deluge water may contain hydrochloric acid and various metal ions (USAF, 1991; USAF, 1988). Rocket launch facilities are typically equipped with catchment basins at the launch pad to catch and treat deluge water.

Wastewater at the types of government and contractor facilities which could accommodate NMD activities under the Preferred Action is generally treated at onsite federally owned treatment works or sent offsite to publicly owned treatment works. Water from certain industrial activities could have to be pretreated to be acceptable to treatment works. Any facilities discharging wastewater directly to surface waters would pretreat the water and discharge it in accordance with an NPDES permit.

Surface Water Quantity

Most NMD activities under the Preferred Action would be conducted at installations that do not directly withdraw surface water, although some installations could be supplied by municipal water systems that are fed by surface water. Because many of these types of installations do withdraw groundwater, water requirements and consumption by NMD activities are detailed in the environmental consequences discussion for groundwater (Section 4.8.1.1) and site-specific hydrologic investigations may be necessary in the future. The very low anticipated water requirements for NMD activities could, however, be withdrawn from most large rivers, lakes, or reservoirs without adverse hydrological or ecological impacts. Although power could be supplied to some installations by power plants which withdraw surface water for cooling purposes, the power requirements for NMD activities would generally be very low and would not require increased power generation capacity or increased cooling water withdrawals.

Floodplains

Some NMD activities under the Preferred Action could be conducted at existing government installations in areas subject to coastal flooding (coastal floodplains). Many such installations are located on barrier islands, atolls, and other coastal areas subject to storm surges and tsunamis (seismic waves). These locations are favored for test-firing and launching because trajectories can be directed over the ocean, away from inhabited areas. Any construction activities performed at these installations to accommodate NMD activities would be minor and would not measurably alter coastal flood hydrology. Any new construction necessary to modify inland installations would avoid floodplain encroachment to the extent possible. Minor

construction activity in floodplains could be necessary to install roads, utilities, and communication lines.

4.7.1.2 Mitigation Measures

Surface Water Quality

Water quality impacts could be reduced to minimal levels through several practices designed to prevent contaminants from reaching surface waters. Effective mitigation measures designed to protect surface water from inadvertent contamination are a part of the following plans normally prepared and implemented by industrial facilities:

- SPCC Plans. SPCC plans specify practices to prevent the leakage or spillage of liquids that could contaminate surface water or groundwater and measures to rapidly and effectively contain and clean up liquids that do spill.

- Stormwater Management Plans. Stormwater management plans specify practices to contain and treat stormwater runoff from impervious surfaces such as launch sites and other paved work areas, parking lots, and structures. Industrial facilities are also presently required to obtain NPDES permits before allowing stormwater runoff to enter surface water.

- Soil Erosion and Sediment Control Plans. Soil erosion and sediment control plans specify practices to stabilize soils exposed during construction activities and prevent eroded soil from reaching surface water. Examples include vegetative stabilization of soils, installation of silt fences or straw bale dikes to intercept sediment, and avoidance of soil disturbance on steep slopes. In addition, NPDES permits are required for construction activities which disturb five or more acres of land area.

Many, but not all, state and local jurisdictions require the preparation and approval of the above plans and set minimal standards for their preparation and implementation. All plans would be approved and would meet applicable state and local criteria. In state or local jurisdictions lacking requirements for these plans, plans could be prepared following federally recognized best management practices.

Several additional mitigation measures could be adapted to minimize surface water quality impacts related to GBI test-firing and rocket launches. Installations could be equipped with catchments to trap deluge water and other runoff from launch and test-firing sites. Launches and test-firings could be scheduled, when practicable, to avoid periods of rain and to coincide with wind speeds and directions that would minimize the exposure of surface water to exhaust clouds. The trajectories of GBIs and rockets

could be directed, when practicable, over the ocean, where most solid debris would have no potential to affect water quality. If solid debris were to fall in inland or nearshore coastal waters, it would be rapidly recovered.

Surface Water Quantity

The water demands of most NMD activities would be met through groundwater withdrawals or water supplied by municipal water systems. Therefore, mitigation measures would not be necessary to offset surface water withdrawals. If surface water withdrawals were necessary, site-specific hydrologic and hydraulic data would be collected as necessary to determine how the withdrawals could impact the affected water body. Appropriate federal and state agencies (including the U.S. EPA, U.S. FWS, U.S. Army Corps of Engineers [U.S. COE], and state water resource management agencies) would be consulted to determine if there could be potential impacts to fish and wildlife habitat, downstream navigation, or hydroelectric power production. Appropriate mitigation measures would be developed in response to recommendations provided by these agencies.

Floodplains

Practicable alternatives that avoid floodplains would be considered prior to any construction activity in floodplains. Opportunities to extend utilities across rivers by attachment to bridges, trestles, or other existing structures without impacting floodplains or riparian vegetation would be examined. Trenches for installation of underground utilities or other temporary ground surface disturbances within floodplains would be backfilled to the original grade within the shortest practicable time. Excess backfill material would be removed from the floodplain for disposal. Exposed soils in floodplains would be stabilized by seeding indigenous vegetation.

If it were necessary to place any permanent fill material in a floodplain, appropriate hydrologic analyses would be performed to ensure that no substantial increases in flood hazard to other property occurred. Any structures which would have to be constructed in the floodplain would be floodproofed according to specifications set by the Federal Emergency Management Agency.

4.7.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.7.2.1 Development and Testing

The types of potential impacts to surface water in the development and testing life-cycle phase of this Alternative would not generally differ from those described for the Preferred Action in Section 4.7.1.1. Although there

could be more frequent laboratory and field-testing activities and more test launches at more facilities than under the Preferred Action, the risk of surface water contamination could still be effectively reduced through the mitigation measures discussed in Section 4.7.1.2. As for the Preferred Action, surface water would not generally be withdrawn to directly support NMD activities, and new construction within floodplains, especially inland floodplains, would not be likely.

4.7.2.2 Later Life-Cycle Phases

The types of potential impacts to surface water in the later life-cycle phases would not generally differ from those in the development and testing phase. Surface waters near installations accommodating later life-cycle NMD activities would be subject to the same sources of inadvertent contamination, but the same types of mitigation measures could effectively reduce the risk. Basing ground-based elements could involve the exposure of larger areas of soils, presenting a greater sedimentation threat to streams and rivers unless effective erosion control measures were followed. Increased regional population levels from basing ground-based elements in remote areas could induce private land development, which could contaminate streams and other surface waters with stormwater runoff and sediment.

Surface waters near sites used for rocket launches to deploy or service space-based elements or for annual service practice rounds of GBIs would be subject to contamination from exhaust clouds, falling debris, and deluge water runoff, as discussed for the Preferred Action. Only a few launch and test-fire events would take place each year, and, as discussed for the Preferred Action, the impacts of these events to surface water would generally be minimal or capable of effective mitigation.

Decommissioning ground-based elements, especially GBI farms, could pose additional potential sources of inadvertent surface water contamination. Washout water used to remove propellants from GBI casings or to scrub contaminated surfaces could contaminate nearby surface waters if it was not first collected and pretreated. Exhaust clouds generated by open burning of unused GBI propellant could contaminate surface water in the same way as could exhaust clouds generated by test-firing or launches. If a large quantity of propellant were burned at once, the collective exhaust cloud could severely acidify nearby surface waters in the short term.

As for the development and testing life-cycle phase, most NMD activities in the later life-cycle phases would be conducted at installations that do not directly withdraw surface water, although some installations could be supplied by municipal water systems that are fed by surface water. However, the generally low anticipated water requirements for most NMD activities could be withdrawn from most large rivers, lakes, or reservoirs

without adverse hydrological or ecological impacts. Operation of some ground-based elements, especially some types of ground-based sensors, could require the construction of on-site power generation capacity. Water could have to be withdrawn from nearby surface waters to serve as cooling water.

As for the development and testing life-cycle phase, many NMD activities in the later life-cycle phases could be conducted at existing government installations in areas subject to coastal flooding. Additional construction attributable to NMD activities at these installations would generally be minor and would not measurably alter coastal flood hydrology. Basing the battle management, command, control and communications element (BM/C3) could require excavating trenches across both coastal and riverine floodplains to install communications lines. However, the trenches would be backfilled to the original grade and seeded following installation so as to not alter floodflow hydrology. Similar floodplain encroachments could be necessary to install underground utilities.

4.7.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.7.1.2 could be applicable to this Alternative.

4.7.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.7.3.1 Development and Testing

The types of potential impacts to surface water in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.7.1.1 for the Preferred Action. However, there would be somewhat fewer launches under this Alternative and therefore slightly fewer impacts to surface water.

4.7.3.2 Later Life-Cycle Phases

The types of potential impacts to surface water in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.7.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, there would be a greater number of ground-based facilities requiring construction under this Alternative, resulting in a greater potential for surface water sedimentation. There could be a greater potential for surface water contamination from spills, leaks, and stormwater runoff. There would also be a greater number of ground-based facilities requiring decommissioning under this Alternative, resulting in a greater potential for decommissioning-related impacts to surface water. But

adherence to the mitigation measures discussed in Section 4.7.1.2 (including SPCC plans, stormwater management plans, and soil erosion and sediment control plans) could minimize the potential for surface water contamination.

4.7.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.7.1.2 could be applicable to this Alternative.

4.7.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.7.4.1 Development and Testing

The types of potential impacts to surface water in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.7.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.7.4.2 Later Life-Cycle Phases

The types of potential impacts to surface water in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.7.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. There could be construction of more GBI farms and other GBI-related facilities under this Alternative, resulting in a greater potential for surface water sedimentation. There could also be a greater potential for surface water contamination from spills, leaks, and stormwater runoff due to the larger number of ground-based facilities operated under this Alternative. There would be a greater number of GBI farms and other GBI-related facilities requiring decommissioning under this Alternative, resulting in increased potential for decommissioning-related impacts to surface water.

4.7.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.7.1.2 could be applicable to this Alternative.

4.8 GROUNDWATER

Although groundwater underlying land and facilities used by NMD activities under the Preferred Action or the System Acquisition Alternatives would be subject to accidental contamination by runoff, and subsequent percolation, or by spills or leaks of hazardous liquids, the risk could be effectively

reduced through mitigation measures such as basins to catch and treat runoff and adherence to SPCC plans, including best management practices for handling hazardous liquids.

Many installations accommodating NMD activities could rely upon direct groundwater withdrawals or upon municipal water systems supplied by groundwater to meet their water demands. The modest water demands of NMD activities under the Preferred Action or the development and testing phase of the System Acquisition Alternatives would not threaten most aquifers with overdraft and closely associated adverse impacts such as land subsidence or salt water intrusion. Also, aquifers would not be likely to suffer from indirect increases in regional water demand caused by the anticipated modest increases in regional employment and population increases associated with those activities (Section 4.13). However, some particularly sensitive aquifers, such as fragile freshwater lenses underlying some oceanic islands or coastal barrier islands, could be adversely affected by even very minor water withdrawal rates. The direct and indirect water demands of some NMD activities under later life-cycle phases of the System Acquisition Alternatives could be larger, although only the most sensitive aquifers would be subject to adverse impacts.

4.8.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.8.1.1 Environmental Consequences

Groundwater Quality

Groundwater underlying land and facilities used by NMD activities under the Preferred Action would be subject to accidental contamination by runoff, and subsequent percolation, or by spills or leaks of hazardous liquids. However, the risk could be effectively reduced through the use of basins to catch and treat runoff and adherence to SPCC plans, including best management practices for handling hazardous liquids. Most activities would utilize existing facilities already possessing adequate facilities for the treatment of runoff. Any rocket launches necessary to develop space-based element technology would take place at existing facilities equipped with containment basins to catch and treat any launch deluge water.

Aquifers experiencing overdraft could be subject to saltwater intrusion when seawater or deeper, saltier groundwater replaces freshwater that has been withdrawn. Some areas with existing groundwater contamination plumes could also be sensitive to groundwater withdrawals, which could influence the rate and direction of plume migration. However, the very low anticipated water demands of activities under the Preferred Action make such impacts to groundwater quality unlikely.

Groundwater Quantity

Many installations accommodating NMD activities could rely upon direct groundwater withdrawals, or upon municipal water systems supplied by groundwater, to meet their water demands. However, the modest water demands of NMD activities under the Preferred Action (a continued Technology Readiness Program) would not threaten most aquifers with overdraft. The net increase in water consumption attributable to NMD activities would generally reflect any net increase in employment. A general range for water consumption at industrial facilities is 57 to 132 liters (15 to 35 gallons) per employee per day (van der Leeden et al., 1990). Although NMD activities may not be strictly analogous to typical industrial situations, this range provides a rough way to estimate potential water consumption directly attributable to NMD activities. Because the largest net increase in employment at any one installation directly attributable to NMD activities under the Preferred Action would be less than 100 persons per day, the maximum increase in water consumption at any installation would be less than 13,200 liters (3,500 gallons) per day.

Test-firing and flight-testing of GBIs would not involve the use of deluge water or otherwise require the consumption of unusual quantities of water. Any rocket launches necessary to develop space-based element technology under the Preferred Action would be conducted at existing Government rocket launch facilities served by water supply systems capable of meeting the regular deluge water requirements of rocket launches. Quantities of deluge water required to launch some common rockets include 1,140,000 liters (300,000 gallons) for the Space Shuttle, 640,000 liters (170,000 gallons) for the Titan IV, and 1,059,915 liters (280,000 gallons) for the Atlas II (NASA, 1978; USAF, 1988; USAF, 1991). Any increase in annual water consumption attributable to a few launches per year is not substantial. Supplying deluge water for five launches per year, each requiring 1,140,000 liters (300,000 gallons) of deluge water, would increase daily water consumption by only 15,500 liters (4,100 gallons). The Preferred Action would require only a small number of rocket launches (probably less than five per year), likely using smaller rockets such as the Delta II.

Most NMD activities under the Preferred Action would be performed primarily by existing staff, and would therefore not substantially increase regional water demand due to the influx of employees and their families or due to indirect job growth (Section 4.13.1.1). Any limited staff augmentation that might be necessary would not increase regional water consumption by quantities that could threaten any but the most sensitive aquifers with overdraft and associated impacts.

Most aquifers not presently in, or close to, a state of overdraft would not be affected by the water consumption increases detailed above. Some

aquifers, such as those supplying water to Vandenberg AFB, have a history of overdraft (SDIO, 1987). The demand for freshwater on Kwajalein Island (one of several islands comprising USAKA) presently exceeds the rate of recharge by rainfall (USASSDC, 1993a). Availability of clean groundwater could be limited at certain locations by the presence of existing contamination.

4.8.1.2 Mitigation Measures

The mitigation measures discussed in Section 4.7.1.2 for preventing contamination of surface water could also effectively prevent contamination of groundwater. With respect to groundwater quantity impacts, the use of water sources other than groundwater could be considered in areas already experiencing serious groundwater overdraft. Examples could include trucked-in water, rainwater catchments, desalinated seawater, or treated wastewater. Water that does not fully meet the Primary Drinking Water Standards could be used for industrial water uses not involving human consumption. Rainwater catchments have traditionally been used to supplement limited fresh groundwater supplies on isolated Pacific islands such as USAKA. A planned desalination plant is expected to further augment potable water supplies at USAKA (USASSDC, 1993a).

4.8.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.8.2.1 Development and Testing

The types of potential impacts to groundwater in the development and testing life-cycle phase of this Alternative would not generally differ from those described for the Preferred Action in Section 4.8.1.1. Although there could be more frequent laboratory and field testing activities and more test launches at more facilities than under the Preferred Action, the risk of groundwater contamination could still be effectively reduced through the mitigation measures discussed in Section 4.8.1.2. Groundwater withdrawal and consumption by NMD activities could be higher, but probably not enough to threaten most aquifers with overdraft. Likewise, increased regional water demands attributable to population growth induced by NMD activities could be somewhat higher, but would not threaten any but the most sensitive aquifers with overdraft.

4.8.2.2 Later Life-Cycle Phases

The types of potential impacts to groundwater during the later life-cycle phases would generally be similar to those in the development and testing phase. Again, the risk of groundwater contamination could be effectively reduced through the use of basins to catch and treat runoff and adherence

to SPCC plans, including best management practices for handling hazardous liquids.

As for NMD development and testing activities, many NMD activities in the later life-cycle phases could rely on groundwater or municipal water systems supplied by groundwater to meet water demands. Because of the larger scale of activities to produce, deploy, and operate a complete NMD system, larger quantities of groundwater might have to be withdrawn from aquifers underlying certain installations. Direct water consumption attributable to NMD activities would generally reflect net increases in employment and range between 57 to 132 liters (15 to 35 gallons) per person per day (van der Leeden et al., 1990). Additional groundwater withdrawals could be necessary to supply deluge water to launch rockets to deploy or service space-based elements. As many as five launches per year, requiring between 104,000 liters (27,500 gallons) for a Delta II and 640,000 liters (170,000 gallons) for a Titan IV of groundwater to supply deluge water could be necessary to deploy and service space-based elements.

As for NMD development and testing activities, increases in net employment at locations of later life-cycle activities could increase regional population, and thus regional water demands. Although the increased water demands would not generally overwhelm most aquifers, this could happen if facilities were based in remote locations with limited groundwater availability. Such facilities could have to be staffed primarily from outside locations, substantially increasing regional population.

Groundwater might also have to be withdrawn to decommission many ground-based NMD facilities. Large amounts of washout water and other water could be briefly required to clean out GBIs and associated facilities. Conversely, there could be a net out-migration of employees and their families from some remotely based NMD facilities following decommissioning, thus reducing regional water consumption.

4.8.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.8.1.2 could be applicable to this Alternative.

4.8.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.8.3.1 Development and Testing

The types of potential impacts to groundwater in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.8.1.1 for the Preferred Action. The lower level of testing

associated with this Alternative could result in fewer impacts to groundwater.

4.8.3.2 Later Life-Cycle Phases

The types of potential impacts to groundwater in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.8.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. Since it would not be necessary to deploy or maintain space-based components, there would be no need to withdraw groundwater to supply rocket deluge water. Because there would be more ground-based facilities, there could be greater groundwater consumption and a greater risk of groundwater contamination from spills, leaks, and the percolation of stormwater runoff. There would also therefore be a greater potential for decommissioning-related groundwater impacts. But adherence to the mitigation measures discussed in Section 4.8.1.2 could effectively minimize this risk. The magnitude of groundwater withdrawals at each ground-based installation under this Alternative would not substantially differ from those under the Preferred Action, but a greater number of installations could experience withdrawals.

4.8.3.3 Mitigation Measures

The mitigation measures outlined in Section 4.8.1.2 could be applicable to this Alternative.

4.8.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.8.4.1 Development and Testing

The types of potential impacts to groundwater in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.8.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.8.4.2 Later Life-Cycle Phases

The types of potential impacts to groundwater in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.8.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. Groundwater withdrawals would be required to supply deluge water for rockets used to deploy SBSs, but not for rockets used to deploy SBIs.

There could be a larger number of GBI farms and other ground-based facilities, and thus there could be a greater potential for impacts to groundwater. Although there could be a greater potential for groundwater contamination from spills, leaks, and the percolation of stormwater runoff, adherence to the mitigation measures discussed in Section 4.8.1.2 could effectively minimize the potential for contamination. The magnitude of groundwater withdrawals at each ground-based installation under this Alternative would not substantially differ from those under the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative, but a greater number of installations could experience withdrawals. Since there would be a larger number of ground-based facilities requiring decommissioning, there would be a greater potential for decommissioning-related impacts to groundwater. There would be a greater potential for groundwater contamination from spills, leaks, and the percolation of runoff from washout water used in decommissioning GBIs. The magnitude of groundwater withdrawals to decommission each ground-based installation under this Alternative would not substantially differ from those under the Preferred Action, but a greater number of installations could require withdrawals.

4.8.4.3 Mitigation Measures

The mitigation measures outlined in Section 4.8.1.2 could be applicable to this Alternative.

4.9 VISUAL RESOURCES

NMD activities under the Preferred Action or under the development and testing life-cycle phase of the System Acquisition Alternatives would generally take place inside existing industrial buildings on existing government installations and contractor facilities. Any exterior modification or new construction would generally be consistent with the existing condition of the surroundings. Launches and some exterior field testing activities could be partially visible to residents living near existing government and contractor installations presently engaged in similar activities. There would be greater potential for visual intrusion into rural landscapes by new construction during the later life-cycle phases of the System Acquisition Alternatives.

4.9.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.9.1.1 Environmental Consequences

Most NMD activities under the Preferred Action would take place inside existing industrial buildings on existing government installations and contractor facilities. The external appearance of these buildings would not

generally change. Some NMD activities could require expansion or exterior modification of existing industrial buildings (and appurtenant facilities such as parking lots) permanently altering their appearance but not affecting their overall industrial appearance. Construction of new facilities, if necessary, would generally be limited to areas whose surroundings are already industrial. These locations would generally be within previously developed industrial areas of existing installations or within industrial or office parks. Reduced visibility as the result of increased activities at certain facilities could affect the viewshed of adjacent areas.

Some test elements, such as GBSs or GEPs, could have to be constructed, but they generally would be constructed either in areas not visible to the public or in areas already industrial in appearance. Field testing activities, including GBI static firings and test launches of targets or rockets to carry space-based test components aloft, would generally take place within existing government installations, where large perimeter buffers would exclude most ground activities from public view. Some ground activities could still be partially visible from residences near installation perimeters, but these activities would generally appear to resemble other ongoing field activities conducted at these installations. Elements of launches could potentially be visible as far as 48 kilometers (30 miles) away. Other airborne activities such as target overflights to test GBSs could also be visible from public areas.

4.9.1.2 Mitigation Measures

Mitigation measures could include constructing any necessary new facilities in visually compatible areas, screening views of facilities from nearby residences (through the use of vegetation, fences, or other visual barriers), and constructing facilities with materials and colors compatible with the surrounding environment. Regular maintenance of facilities would maintain their appearance. Mitigation measures for decommissioning could include restoring the areas by revegetation and disposing of debris in accordance with all federal, state, and local regulations.

4.9.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.9.2.1 Development and Testing

The types of potential impacts to visual resources in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section 4.9.1.1 for the Preferred Action.

4.9.2.2 Later Life-Cycle Phases

The types of potential visual impacts in the later life-cycle phases would not generally differ from those in the development and testing phase. However, there could be a greater potential for visual impacts related to new construction while basing ground-based elements. Although some ground-based elements would be based on existing government installations (or contractor facilities), where they would be visually compatible with existing conditions, ground-based elements may also have to be based in areas not presently supporting industrial development. Although an attempt would be made to site ground-based elements in visually compatible areas or areas not easily visible to the public, it could be necessary to construct ground-based elements in rural or naturalistic landscapes that are visible to the public. In forested areas, tree removal could be required to install and maintain buried communications lines, affecting the appearance of forested landscapes distant from the locations of ground-based structures. Additional tree removal could be necessary to maintain clear zones necessary to operate GBSs.

Decommissioning ground-based elements could require demolition or removal of buildings and other structures, permanently altering the appearance of their surroundings. Debris from demolition activities could be temporarily visible at the site. Open burning of unused propellants or debris could be briefly visible to surrounding areas. There would not be any visual impacts from decommissioning space-based elements, which would generally involve parking the elements in safe orbits for an indefinite period of time.

4.9.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.9.1.2 could be applicable to this Alternative.

4.9.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.9.3.1 Development and Testing

The types of potential visual impacts in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.9.1.1 for the Preferred Action.

4.9.3.2 Later Life-Cycle Phases

The types of potential visual impacts in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those in Section 4.9.2.2 for the Ground- and Space-Based Sensors and

Ground- and Space-Based Interceptors System Acquisition Alternative. However, because all interceptors and sensors would be ground based, this Alternative could have a greater overall potential for visual impacts. More localities could experience visual impacts because of the greater number of ground-based facilities. Launch-related impacts, however, would be less under this Alternative.

4.9.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.9.1.2 could be applicable to this Alternative.

4.9.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.9.4.1 Development and Testing

The types of potential visual impacts in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.9.1.1 for the Preferred Action.

4.9.4.2 Later Life-Cycle Phases

The types of potential visual impacts in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.9.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, more localities could experience visual impacts because of the greater number of ground-based facilities under this Alternative. Launch-related impacts, however, would be substantially less under this Alternative.

4.9.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.9.1.2 could be applicable to this Alternative.

4.10 CULTURAL RESOURCES AND NATIVE POPULATIONS

Most NMD activities under the Preferred Action or under the development and testing life-cycle phase of the Systems Acquisition Alternatives would utilize existing facilities with a history of similar activities. A few activities could require facility expansion or construction of new facilities, potentially resulting in irreversible physical disturbance of surface or subsurface cultural resources. Certain infrequently conducted activities, such as interceptor flight tests and rocket launches, could contribute to acidic precipitation and generate brief periods of noise that detract from historic or cultural settings but is negligible compared to emissions from other sources. Later life-cycle

phases have the potential to cause greater impacts to cultural resources and Native populations, but this potential could generally be reduced through compliance with Section 106 of the National Historic Preservation Act (NHPA 16 USC 470 et seq.), the American Indian Religious Freedom Act (AIRFA, 42 USC 1996 et seq.), and other regulatory requirements.

4.10.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.10.1.1 Environmental Consequences

Most NMD activities under the Preferred Action (a continued Technology Readiness Program) would utilize existing facilities with a history of similar activities and would not require grading, structure demolition, or other actions which could cause irreversible physical destruction of cultural resources. Certain activities could require razing or renovating structures or grading small tracts of land within developed parts of existing government or contractor installations. Although these developed areas could contain historic structures associated with 20th-Century military events, the occurrence of earlier historic structures or intact archaeological resources is unlikely. If it is necessary to construct facilities outside of existing installations or to develop greenfield tracts of land within these installations, surveys would be conducted to identify and avoid locations of significant cultural resources.

Activities that generate air emissions (Section 4.1.1.1) could contribute to acidic precipitation, which is capable of corroding surface materials such as concrete or steel that comprise some historic structures. Acidic precipitation also could damage earthen materials comprising prehistoric resources, such as rock carvings. However, maximum concentrations of acidic compounds from rocket exhaust are expected to be of limited duration and to readily disperse. Activities that generate high noise levels (Section 4.5.1.1) could be incompatible with certain historic settings and could interfere with traditional Native ceremonies. Certain activities could be visually incompatible with certain historic settings (Section 4.9.1.1).

Some NMD activities could require fire suppression procedures which could affect cultural and Native resources. Fire suppression activity could involve removal of vegetation within a launch safety zone. If the launch safety zone was within a sensitive cultural resource area, removal of vegetation could impact these resources. Impacts also could include erosion caused by the spraying of water to extinguish a fire and changes in chemical constituents of the soil that could alter the preservation of materials such as bone, shell, and wood (USASDC, 1992).

Debris recovery has the potential to be damaging to cultural resources. Installations that routinely conduct launches have established procedures for

the recovery of launch debris and boosters which protect resources. Off-road vehicles, used in the recovery of debris, could damage cultural resources. The debris itself would not likely cause much damage since it would be very localized.

Site-specific consultation, research, and field surveys could be necessary to determine whether specific activities could affect cultural and Native American resources. The results of these efforts would be included in future environmental documentation. It might not always be possible to site every activity without impacting cultural and Native resources.

4.10.1.2 Mitigation Measures

All surveys, studies, and consultations required under Section 106 of the NHPA, the AIRFA, and other statutes would be performed. Findings would be presented in future environmental documentation. Surveys would be conducted as required under the NHPA to determine whether cultural or Native American resources which are listed or eligible for listing on the National Register of Historic Places and exist on or close to each site. If the surveys indicated that resources could be adversely affected by an NMD activity, all practicable efforts would be made to relocate or redesign the activity to avoid the impacts.

Several types of mitigation measures involving avoidance could be possible. If any new construction and other ground disturbances are necessary, minor adjustments in plans could sometimes avoid areas with surface or subsurface cultural resources. Cultural resources could be protected from noise, visual intrusion, or acidic precipitation or activities that cause these could be located away from cultural resources. Impacts to traditional ceremonies could be reduced or eliminated by timing activities that create visual or auditory intrusions (such as ground tests or live fire tests) so that they would not conflict with ceremonies.

Mitigation measures for debris recovery could include the minimal use of off-road vehicles, the presence of an archeologist during recovery, and procedures for the unexpected discovery of resource disturbances. This includes consultation with interested agencies such as State Historic Preservation Offices and the Advisory Council on Historic Preservation.

4.10.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.10.2.1 Development and Testing

The types of potential impacts to cultural resources in the development and testing life-cycle phase of this Alternative would not generally differ from

those described for the Preferred Action in Section 4.10.1.1. However, there could be more frequent field testing and test launch activities at more installations and facilities than under the Preferred Action. Noise could thus interfere with more historic or Native American settings for somewhat longer periods of time than under the Preferred Action. Also, there would be potentially more launch debris to recover.

4.10.2.2 Later Life-Cycle Phases

The types of potential impacts to cultural resources during the later life-cycle phases would generally be as described for the development and testing phase. Because most production activities would take place at contractor rather than government installations, they would present less potential for impacts to historic structures associated with the military or federal government. Conversely, the potential for direct physical disturbance of cultural resources from ground-disturbing and construction activities would be greater during the basing of ground-based NMD elements. Because these elements would be based at widely scattered locations, there could be a greater potential to impact a greater diversity of cultural and Native resources. There would be little potential for impacts to historic structures or previously undisturbed archaeological sites during decommissioning. Some decommissioning activities, such as open pit detonation, could generate brief, temporary periods of noise capable of interfering with distant historic settings or the activities of Native peoples.

4.10.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.10.1.2 could be applicable to this Alternative.

4.10.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.10.3.1 Development and Testing

The types of potential impacts to cultural resources in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.10.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.10.3.2 Later Life-Cycle Phases

The types of potential impacts to cultural resources in the later life-cycle phases of the All Ground-Based Alternative would not generally differ from those described in Section 4.10.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, because a larger number of ground-based facilities

would be based under this Alternative, there could be an increased potential for cultural resource impacts.

4.10.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.10.1.2 could be applicable to this Alternative.

4.10.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.10.4.1 Development and Testing

The types of potential impacts to cultural resources in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.10.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. Also, there would be potentially more launch debris to recover.

4.10.4.2 Later Life-Cycle Phases

The types of potential impacts to cultural resources in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.10.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, because a larger number of ground-based facilities would be based under this Alternative, there could be a greater extent of cultural resource impacts.

4.10.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.10.1.2 could be applicable to this Alternative.

4.11 BIOLOGICAL RESOURCES AND WETLANDS

Because most NMD activities under the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would utilize existing facilities or require only small areas of new construction, encroachment into natural habitats, including wetlands and habitat used by threatened and endangered species, would generally be limited. Few of these activities would require substantial staff augmentation, thereby limiting the potential for encroachment into natural habitats induced by regional population growth. However, birds and other airborne fauna passing within EMR beams generated by testing radars could be injured. The potential for natural habitat encroachment could be greater during the later life-cycle phases of the System Acquisition Alternatives, when it would be necessary to perform greater amounts of new construction. Any

temporary or minor effects on air quality (Section 4.1), surface water quality (Section 4.7), and any noise generation (Section 4.5), could indirectly affect natural habitats.

4.11.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.11.1.1 Environmental Consequences

Natural Habitats

Since most NMD activities under the Preferred Action would utilize existing facilities or only require small areas of new construction, only small areas of natural habitat would be lost. Furthermore, most new construction would take place within previously developed parts of existing government installations or contractor facilities, thereby not fragmenting or introducing human activity into large tracts of natural habitat. Few NMD activities would require substantial staff augmentation. Thus, indirect losses of natural habitat outside of government or contractor installations due to new housing construction would be minimal. Where new construction were required, however, small areas of natural habitat could be lost, although not to the extent that regional or global biodiversity could be reduced.

Natural habitats close to areas accommodating GBI test-firing and rocket launching activities would be subject to infrequent periods of noise generated by NMD activities under the Preferred Action. Noise from launches could affect wildlife in several ways, including causing behavioral and physiological effects (e.g., changes in nesting behavior or an increase in heart rate) (Doufour, 1971). However, most effects to animals caused by rocket noise would likely be temporary and disappear within 10 to 48 hours. Studies conducted on birds (including endangered species such as the peregrine falcon, *Falco peregrinus* and bald eagle, *Haliaeetus leucocephalus*) have shown that noise from launches and focused sonic booms has little effect on nesting success, adult mortality, or territory use. Auditory damage to marine and terrestrial birds would not be likely, since most of these birds are insensitive to sounds of wavelengths below 100 Hz. It has been suggested that launch noise and sonic booms from launch vehicles may temporarily disturb breeding and pupping behavior of marine mammals in coastal areas. However, repeated attempts to determine the impacts of noise and sonic booms on pinnipeds (e.g., seals, sea lions, and walruses) have failed to document significant responses (USAF, 1991).

Air emissions from launches may result in short-term, localized impacts to the terrestrial fauna found in the immediate vicinity of the launch pad. Due to the relatively innocuous nature of the major propellants and their combustion products, air quality impacts to wildlife are expected to be insignificant (USAF, 1991).

During a launch, much of the deluge water evaporates forming an acidic cloud. Terrestrial animals in the immediate vicinity of the launch site could come in contact with this acidic mist for a short period. However, this contact is not expected to have a significant impact on wildlife, since the exhaust cloud will be present only briefly, and any mist that settles out of the cloud will evaporate quickly (USAF, 1991).

Short-term impacts to aquatic systems in the vicinity of rocket test ranges have resulted in fish kills induced by water pH reduction. However, pH levels returned to normal through natural processes within a few days. Exhaust from NMD launching activities would not likely result in long-term impacts to aquatic ecosystems (USAF, 1983).

Natural habitats adjoining facilities that store or handle hazardous liquids associated with NMD activities under the Preferred Action (such as liquid fuels and propellants) would be subject to inadvertent contamination through leaks or spills. Implementation of routine precautions under an approved SPCC plan, including best management practices for the handling of hazardous liquids, should effectively reduce this risk. Habitats adjacent to areas where GBI test firings or rocket launches take place could be subject to brushfires, although routine fire prevention measures would reduce this risk.

Terrestrial wildlife could be exposed to non-ionizing EMR emissions from several sources associated with NMD activities under the Preferred Action, including electrical power lines, communications antennae, and radars. However, scientific research to date suggests that there is little potential for wildlife to be injured by EMR associated with power lines or communications antennae. Representative research to support these findings include studies of the effects of 500-kilovolt (kV) transmission line rights-of-way on large and small mammals. Other research involving a 1,200-kV electric transmission line did not reveal any adverse impact to nearby wildlife. Ecological studies of songbirds near electric power line rights-of-way have suggested that their behavior is influenced more by vegetation than by electric and magnetic fields. In another study, hawks nesting on power line towers were found to produce the same number of young as hawks nesting on trees and cliffs (U.S. DOE, 1989). Electric power line construction should not be necessary under the Preferred Action except to supply the large quantities of power necessary to test radars associated with GBSs. Considering that the Perimeter Acquisition Radar site in North Dakota (similar to radars that would be tested under the Preferred Action) is served by a 69-kV electric line, any electric lines constructed under the Preferred Action would be much lower than the 500 kV and higher lines used in the studies discussed above.

The EMR generated by communications antennae such as those to be tested under the Preferred Action is likewise thought not to be capable of injuring

wildlife. A study conducted from 1986 to 1989 concluded that the EMR generated from a communications antenna operating at a frequency of 76 Hz did not affect bird species or populations. Evidence did not indicate that overall bird distribution was affected by EMR produced by the antenna. Measured differences between reference and treatment areas were attributed to seasonal changes in habitat selection and inconsistencies in annual weather patterns during the study period (Hanowski et al., 1993).

In contrast, wildlife passing within the main beam or sidelobes of EMR generated by the large, phased-array radars that would be tested under the Preferred Action could be seriously injured. Birds and other flying animals would be most at risk, since the main beam would be oriented skyward. However, nonflying wildlife in the immediate vicinity of the radars could also be affected by sidelobes. Research concerning radar-generated EMR has shown that thermal-related effects are the most common impact to biological systems. Acute EMR exposures to animals above approximately 100 kHz normally induce an increase in body temperature or responses to minimize heat load (NRPB, 1992). Observations of microwave EMR and animal behavior indicate that animals avoid EMR as a result of a thermoregulatory response in warm environments but tend to seek it out in cold environments to gain warmth (Earth Technology Corporation, 1993). Furthermore, microwave EMR has not been conclusively demonstrated to be non-carcinogenic to animals (NRPB, 1992).

Based on research on the biological effects of EMR, it appears that body temperature increases could begin to occur at exposures to average radar power densities above 1 mW/cm^2. The degree of impact would depend on how much the 1 mW/cm^2 power density is exceeded, the distance from the beam source, the length of exposure, the specific absorption rate (SAR) of the animal, the animal's ability to regulate body temperature, and weather conditions related primarily to temperature and humidity. Of primary concern would be the power density of the EMR emitted from the main beam, since the power density of the sidelobes is at most 0.8 percent of the main beam power density (USASSDC, 1993a). Since the main beam is aimed skyward, only birds and other airborne fauna would be subject to a strongly injurious EMR (U.S. Air Force School of Aerospace Medicine, 1983).

Debris recovery has the potential to be damaging to biological resources. Installations that routinely conduct launches have established procedures for the recovery of launch debris and boosters which protect resources. Off-road vehicles, used in the recovery of debris, could damage biological resources. The debris itself would not likely cause much damage since it would be very localized.

Wetlands

The potential for wetland losses under the Preferred Action would be limited due to limited encroachment into natural habitats. Most wetland losses would be permitted under one or more of the Nationwide General Permits under Section 404 of the Clean Water Act (33 CFR 330), for which impacts have been determined to be cumulatively of minimal impact. In the event that a Nationwide General Permit does not apply to a specific action, application would be made for an individual Section 404 permit. Tidal marshes near coastal rocket launch and test-firing facilities could be subject to exhaust clouds, but as discussed in Section 4.7.1.1, the impacts of such clouds on surface water, including wetlands, are generally minimal. Implementation of SPCC plans would effectively reduce the potential for wetland contamination by propellants and other hazardous chemicals, and implementation of soil erosion and sediment control plans would effectively reduce the potential for sedimentation of wetlands. Because of the relatively low water demands of most NMD activities under the Preferred Action (discussed in Section 4.8.1.1), there would be little potential to hydrologically deplete wetlands through groundwater withdrawals.

Threatened and Endangered Species

Since most NMD activities under the Preferred Action would use existing facilities, and because most of these activities would resemble ongoing activities at those facilities, the potential for impacts to threatened and endangered species would be limited. However, where activities would have to encroach into natural habitat, or where activities would increase noise or the human presence in surrounding natural habitats, site-specific surveys would be necessary to determine whether threatened or endangered species could be affected. Many NMD activities would have to be performed in coastal areas, which provide habitat for such threatened and endangered species as the bald eagle and several sea turtle species (Family Chelonidae), or on oceanic islands, which provide habitat for such threatened and endangered species as the Mariana fruit bat (*Pteropus mariannus mariannus*) and the small Kauai thrush (*Myadestes palmeri*).

Migratory Birds

Although migratory birds could be affected by minor encroachments into natural habitats under the Preferred Action, the limited extent of these encroachments would minimize impacts. However, migratory birds would be subject to injury from EMR beams from radars tested under the Preferred Action. Activities cited within the migratory flyways shown in Figure 3-13 would have a greater potential to cause impacts.

4.11.1.2 Mitigation Measures

Mitigation measures outlined in Section 4.5.1.2 to address the impacts of noise on humans could also address noise impacts to wildlife. Mitigation measures outlined in Section 4.3.1.2 to address EMR emissions could also address EMR impacts to wildlife. Mitigation measures outlined in Sections 4.4.1.2 and 4.7.1.2 to address the accidental or unintentional release of hazardous materials or surface water contaminants could address the potential exposure of terrestrial and aquatic biota to toxic materials.

Formal consultation procedures would be initiated with the U.S. Fish and Wildlife Service before beginning any activity that may affect species listed as endangered or threatened under the Endangered Species Act, or their designated critical habitat. In addition, formal conferencing procedures would be initiated before any activity that could jeopardize the continued existence of any species proposed for listing, or modify or adversely affect critical habitat(s) proposed for those species.

Additional mitigation measures could be recommended by the U.S. FWS in conjunction with Section 7 of the Endangered Species Act (16 USC 1531 et seq.) and the Fish and Wildlife Coordination Act (16 USC 661 et seq.). These could include, but are not limited to, shielding sources of non-ionizing radiation to contain or reduce steady or transient electromagnetic effects, using standard operating procedures approved by appropriate professional associations, such as the ANSI or IEEE, conducting operational monitoring of the workplace and nearby environments during operation for hazardous parameters, and using fencing to exclude animals from potentially hazardous areas. Vegetation in the safety zone surrounding radars could also be removed to discourage local airborne animals from feeding or nesting in the area. Furthermore, avoidance of local flyway patterns, such as between bird nesting and feeding areas, could be considered to the extent practicable when siting radars (SDIO, 1991b). Mitigation measures to minimize the potential for igniting vegetation near launch facilities could include using blast deflectors and keeping emergency fire crews available to extinguish any fires that could occur.

Other mitigation measures could be implemented to minimize impacts to wildlife and wildlife habitat. Examples include restricting site personnel to work areas, limiting the use of off-road vehicles, designing power lines to avoid electrocution of large raptors, implementing a soil erosion and sediment control plan, and coordinating debris recovery with natural resource agencies such as the U.S. FWS and Game and Fish departments following launches where sensitive habitats are involved.

4.11.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.11.2.1 Development and Testing

The types of potential impacts which may occur to biological resources and wetlands in the development and testing life-cycle phase of this Alternative would not generally differ from those described for the Preferred Action in Section 4.11.1.1. While most activities would use existing facilities with a history of similar activities, there could be slightly more encroachment into natural habitats and noise impacts to wildlife due to increased testing activities. Also, there would be potentially more launch debris to recover.

4.11.2.2 Later Life-Cycle Phases

The types of potential impacts which may occur to biological resources and wetlands during the later life-cycle phases would generally be as described for the testing and evaluation phase. However, basing ground-based NMD elements would require several small, scattered areas of habitat loss or disturbance due to construction. Habitat loss would result in displacement of mobile animals and destruction of other less mobile fauna. Trenching to install utilities and the network of fiber-optic communication lines connecting ground-based elements to the BM/C3 facility could involve both habitat loss and fragmentation of forested habitats. Fragmentation would reduce the suitability of forested habitats for forest-interior-dwelling birds and mammals, many of whose populations are in decline. Wetlands might have to be permanently filled to construct new facilities and access roads, or temporarily disturbed to install utilities and communications lines. Although the extent of wetland disturbance to install communications lines could be substantial due to the distances involved and the necessity of crossing geographically linear wetlands associated with streams and other surface waters, the damage could be readily repaired.

Although decommissioning activities such as structure demolition could generate noise and other short-term impacts to terrestrial wildlife, the long-term impact from discontinuing activities that generate noise, EMR, and other factors that disturb wildlife could be beneficial. Certain wildlife species that use certain NMD structures as nesting sites would be disturbed when those structures were demolished.

4.11.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.11.1.2 could be applicable to this Alternative.

4.11.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.11.3.1 Development and Testing

The types of potential impacts to biological resources and wetlands in the development and testing life-cycle phases of the All Ground-Based System Acquisition Alternative generally would not differ from those described in Section 4.11.1.1 for the Preferred Action. Encroachment into natural habitats could be slightly greater than under the Preferred Action due to increased ground-based testing. Noise impacts to wildlife could be slightly less than under the Preferred Action, since fewer rockets would be launched.

4.11.3.2 Later Life-Cycle Phases

Potential impacts to biological resources and wetlands in the later life-cycle phases of the All Ground-Based System Acquisition Alternative generally would not differ from those described in Section 4.11.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, the extent of natural habitat disturbance resulting from ground disturbance for new construction could be increased relative to the Preferred Action. Greater amounts of habitat could be disturbed to construct a larger number of ground-based components, and the magnitude of potential impacts to wetlands, threatened and endangered species, and migratory birds could be increased. The potential for EMR-related injury to birds and other fauna could be greater under this Alternative due to the greater number of GBSs.

4.11.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.11.1.2 could be applicable for this Alternative.

4.11.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.11.4.1 Development and Testing

The types of potential impacts to biological resources and wetlands in the development and testing life-cycle phases of this Alternative would not generally differ from those described in Section 4.11.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative and would be slightly greater than the Preferred Action.

4.11.4.2 Later Life-Cycle Phases

The types of potential impacts to biological resources and wetlands in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.11.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, there could be increased encroachment into natural habitats because of the greater number of ground-based facilities constructed under this Alternative.

4.11.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.11.1.2 could be applicable to this Alternative.

4.12 LAND USE

NMD activities under the Preferred Action or under the Development and Testing life-cycle phase of the System Acquisition Alternatives would generally utilize land and facilities already dedicated to those activities. A few activities could require the dedication of small areas of additional land or facilities, primarily within existing government or contractor installation boundaries. Later life-cycle phases of the system acquisition process could require dedication of larger areas of land, including land not presently owned by the government or its contractors.

4.12.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.12.1.1 Environmental Consequences

Most NMD activities under the Preferred Action would utilize land and facilities within existing government and contractor installations that are already dedicated to similar activities. Some activities could require the dedication of facilities presently used for other purposes or require the dedication of a few acres (hectares) of additional land within existing installations. These activities would generally be consistent with present land use objectives and plans developed for those installations, as well as with any applicable zoning ordinances. If activities required the purchase or construction of facilities outside of existing government and contractor installations, they would generally be sited in areas already zoned for industrial use and would comply with any applicable zoning ordinances.

Flight tests, static firings, and test launches would be conducted at existing government and contractor installations. The potential for land use impacts would be highly dependent on site-specific environmental characteristics. Typically, test ranges would be in isolated locations and would not be likely

to adversely impact surrounding land uses. Test ranges would not generally be located near urban areas or environmentally sensitive areas such as national parks or federally designated Wild and Scenic Rivers.

Activities such as launches and static missile firings would require surrounding buffers for safety and security. The noise, emissions, and other physical characteristics of these activities could restrict the use of land outside the buffers as well. Most of the selected government installations should be of adequate size that these restrictions would not affect adjoining privately owned land. However small tracts of privately owned land may have to be purchased, or owners compensated for reductions in value to their properties.

Activities performed entirely within government installations would not conflict with local zoning ordinances or with local land use plans (or comprehensive plans) and development objectives. Launching and static firing tests would generally be performed at government installations with a history of similar activities, and would therefore not conflict with local ordinances or land use plans.

Most activities performed at contractor facilities would be compatible with surrounding land uses. Contractors would be subject to local zoning ordinances. Most contractor facilities would be located in areas zoned industrial (or an equivalent zoning classification).

4.12.1.2 Mitigation Measures

Mitigation measures to address land use impacts could include the use of buffer zones (such as vegetative buffers or open space), range extension agreements, easements or other land acquisitions, zoning changes, movement of transportation routes away from sensitive areas, and adjusting the schedule of activity schedule adjustments to lessen the impacts to surrounding areas.

Some land uses could necessitate placing limitations on adjacent owners for safety considerations. For example, to ensure the safety of nearby inhabitants, some test ranges could negotiate agreements with off-range land owners. Under these agreements the adjacent landowners might have to evacuate their lands for a short period during certain test activities.

4.12.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.12.2.1 Development and Testing

The types of potential land use impacts in the development and testing life-cycle phase under this Alternative would not generally differ from those described in Section 4.12.1.1 for the Preferred Action. A greater likelihood exists that additional land or buildings on-site at certain installations may have to be dedicated to support NMD activities under this Alternative.

4.12.2.2 Later Life-Cycle Phases

Since the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative involves acquisition and production activities, potential land uses would be more intense than that of the Preferred Action. Production activities would generally be conducted at contractor manufacturing facilities. These facilities would generally be located in areas zoned industrial (or an equivalent zoning classification) by local zoning ordinances. Construction of new manufacturing facilities could require the dedication of small areas of land within government installations or could take place in areas targeted for industrial development under local land use plans. Production activities in areas of existing industrial development would not be likely to induce restrictions on the use of adjacent land.

Basing NMD components could involve new construction in several local communities. Although many NMD components could be based in existing government facilities, some could require the dedication of undeveloped tracts of installation property for new construction and for buffer zones. As described for testing and evaluation, adequate buffer zones for most NMD facilities would be available within the installation, and there would be little potential for conflict with the use of private property outside the installation. Limited acquisition of private property or other forms of owner compensation could be required.

Several widely scattered tracts of privately owned property could have to be acquired to base ground-based elements. Most such property would have little potential for intensive private development, although small areas of land suitable for residential, commercial, or industrial development may have to be acquired in certain densely populated parts of the country. Adequate buffer zones would also be acquired. Remote ground-based facilities would not be likely to restrict the use of surrounding private land.

Certain decommissioning activities such as mechanical demolition, explosive demolition, static fire detonation, or open detonation could be incompatible

with adjacent land uses. However, these activities would be brief and temporary. Following decommissioning, land could be available for non-BMD related development.

4.12.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.12.1.2 could be applicable to this Alternative.

4.12.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.12.3.1 Development and Testing

The types of potential land use impacts in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.12.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.12.3.2 Later Life-Cycle Phases

The types of potential land use impacts in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.12.2.2 for the Ground- and Space Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, because all BMD elements would be ground-based, larger areas of land may have to be dedicated during basing. More tracts of privately owned land may have to be acquired. Because this Alternative could require larger areas of land, there could be a greater potential for conflicts with adjacent land uses and with local land use objectives.

4.12.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.12.1.2 could be applicable to this Alternative.

4.12.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.12.4.1 Development and Testing

The types of potential land use impacts in the development and testing life-cycle phase of this Alternative would not generally differ from those described in Section 4.12.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.12.4.2 Later Life-Cycle Phases

The types of potential land use impacts in the later life-cycle phases of this Alternative would not generally differ from those described for ground-based elements in Section 4.12.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. The overall magnitude of land use impacts could be greater because of the greater number of ground-based components. More tracts of privately owned land may have to be acquired to base the additional number of ground-based components, leading to a greater potential for land use conflicts.

4.12.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.12.1.2 could be applicable to this Alternative.

4.13 SOCIOECONOMICS

NMD activities under the Preferred Action or the development and testing life-cycle phase of the systems acquisition alternatives would either (1) have no adverse effect on a community's socioeconomic system, or (2) be unknown at the programmatic level and potentially require further analysis at a regional or local level to determine potential adverse socioeconomic and environmental effects. Appendix K presents a detailed description of potential socioeconomic effects (Section K.4), the methodology and technical approach to assess socioeconomic effects (Sections K.1 and K.2), and definitions of terms used to describe socioeconomic effects (Section K.3).

4.13.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.13.1.1 Environmental Consequences

Battle Management, Command, Control and Communications Element

The BM/C3 element would be tested at an existing remote Government installation such as the USAKA installation in the South Pacific. Operations and construction activities could require additional resources from outside the region. Although existing labor would generally be utilized, some in-migration of labor to support these activities may occur due to specialized program requirements. Therefore, further analysis could be required at the regional or local level to identify potential impacts.

Increased population associated with increased employment could directly affect the demand for housing and other support facilities and services;

including recreation, education, and public health. The extent of these impacts would depend on the duration of an activity, capital requirements, and the number of in-migrants associated with the BM/C3 element, relative to the economic capacity of a host community or government installation. For example, the primary potential for socioeconomic impacts at USAKA would involve housing (USASSDC, 1993a).

Ground-Based Interceptors

GBIs would generally be tested at existing government installations and contractor facilities in large to small communities, or in remote locations such as USAKA. The primary issue for medium to large communities is capital requirements to support operations. These areas tend to have available raw materials, equipment, and supplies to support operations because they typically have diversified economic bases and labor forces with inter-industry linkages. In these cases, the use of local capital could require further analysis at the regional or local level to determine secondary economic impacts, as well as environmentally related and direct infrastructure impacts. Potential impacts to medium to large communities from the use of local capital under the GBI element could include:

- Secondary Employment Effects. Depending on capital requirements, these activities could infuse new purchasing power into a local economy from purchases of supplies and material to support development and testing activities. This increased volume for local trade and service firms could create additional demand for employees. Any increased labor requirements would likely be supplied from the resident labor force in medium to large communities.

- Environmental Impacts. The use of capital and raw materials could involve the introduction of hazardous material or pollution-emitting equipment into a local community. The use of these materials could affect the environment, which in turn, could impact a community's standard of living, economic structure, and demographic composition.

- Direct Infrastructure and Utility Impacts. An increase in the use of capital for additional equipment could require infrastructure or utility modifications. A community's infrastructure capacity might not be able to support development and testing activities. For example, a facility might require additional electricity to support an activity, and the community might need to upgrade its utility system to accommodate this modification.

The primary issue for rural areas and small communities under the GBI element is importing of capital, raw materials, and other resources, and its potential effects on trade and distribution channels. These areas tend to have smaller, less diversified labor forces and economic bases with few

inter-industry linkages. Further analysis at the regional or local level may be required to discern potential environmentally-related and direct infrastructure impacts from the use of capital resources.

Further analysis may be required in rural areas to assess the impacts of labor in-migration resulting from GBI element activities. Potential impacts from the in-migration of labor in rural areas would not be likely, but could occur depending on the size and composition of the labor force relative to labor requirements. If in-migration of labor occurs, potential impacts could include secondary employment effects, shortages of goods and services, and temporary housing shortages; however, these effects would be expected to be short term, with the community adjusting to potential impacts in the long run. Socioeconomic impacts from in-migrants (particularly in rural areas) and imports of resources associated with GBI element activities could include:

- Secondary Employment Effects. The in-migration of labor would generate secondary employment from increases in purchasing power into the local economy. Procurement for goods and services in the region to support the GBI element could also generate secondary employment.

- Public Finance Effects. Population in-migration could cause a change in state and local government expenditures, which could be offset by an equivalent change in revenues. This activity could necessitate a change in existing fiscal policy or tax structures or cause a public entity to incur bonded indebtedness depending on public service capacities. If large increases in operational employment relative to existing employment were required, the community's tax base would increase over time as a result of new homes and business structures associated with the NMD activity; however, a lag could exist between the need for expanded services and growth of the tax base.

- Public Service Requirement Increases. The in-migrating population potentially would result in an increased requirement for public services that could be accommodated within existing budgets and would not require an internal transfer of funds, additional staffing, or major equipment. Alternatively, increased public services could be accommodated by additional major capital facilities if NMD-related demand required more services.

- Utilities. In-migrating population and/or commodity imports would have no noticeable effect on operating practices and would not require additional equipment or facilities, or would cause disruptions of service and degradation of existing performance characteristics, requiring new facilities and equipment.

- Transportation. In-migrating population and/or commodity imports would cause either no changes or substantial changes in level of service and total travel time. In either case, the use of additional capital potentially would cause changes in existing transportation conditions, requiring extensive reconstruction or substantial increases in the overall maintenance cycle.

- Nature of Community. The in-migration of new residents into a rural community could alter its social and service structures (Murdock, 1979).

- Environmentally Related and Direct Infrastructure Impacts. These impacts would be similar to those described for medium and large communities.

- Temporary Housing Shortages. Depending on duration of construction activity, short-term impacts would be anticipated during growth and decline cycles of construction activities. During the growth cycle, project demands might exceed the projected vacancy rates. It should be noted that vacant housing units in small communities may be of low quality, making potential shortages even greater (Murdock, 1979). During the decline cycle, excess supply resulting from decreases in project demand would result in increases in net vacancy rates; however, operations would be anticipated to absorb some vacant units. Impacts to housing would be short term because they would not extend beyond the construction period of the GBS project. Increased demand pressures leading to increases in housing costs and rental prices could occur during the period of construction activity. These pressures would most likely be reduced for the long term.

Additional labor and capital could be required to support GBI development and testing activities at USAKA because of specialized program requirements; therefore, the levels of analysis and associated impacts would be similar to those for BM/C3 activities.

Ground-Based Sensors

Socioeconomic impacts resulting from the development and testing of GBSs would generally be as described for GBIs. GBS element construction and operations impacts on USAKA would be similar to those from BM/C3 activities.

Space-Based Elements

Development and testing of space-based elements would be conducted primarily at existing government and contractor facilities and would be considered new operations at these facilities. Socioeconomic impacts

resulting from the development and testing of space-based elements would generally be as described for GBIs.

4.13.1.2 Mitigation Measures

Effective planning at the local level requires systematic analysis of the economic impacts on affected regions. Systematic analysis of economic impacts, in turn, must take into account inter-industry relationships within regions because those relationships largely determine how regional economies respond to project changes (U.S. Department of Commerce, 1992). Further environmental documentation at the regional or local level could discern adverse impacts from NMD activities. Mitigation measures could be included which would reduce potential impacts. Potential measures could include, but would not be limited to:

- Enhancing labor force availability through various employment training and referral systems.
- Supplying temporary housing during housing shortages associated with construction activities.
- Coordinating construction activities with local jurisdictions.

Special considerations could be necessary in the development of mitigation measures involving activities at remote government installations such as USAKA. Construction of additional housing units may be required to meet any increases in personnel associated with NMD activities; however, available land on USAKA is limited. Alternatives to construction of additional housing could include limiting the number of employees with families to reduce housing demand and using leased hotel ships to house temporary personnel, freeing some of the existing and planned space for more permanent employees. Personnel could be housed in open barracks or tents during short periods of peak activity (USASSDC, 1993a).

4.13.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.13.2.1 Development and Testing

The types of potential socioeconomic impacts in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section 4.13.1.1 for the Preferred Action. However, the frequency and magnitude of these impacts could be somewhat greater under this Alternative.

4.13.2.2 Later Life-Cycle Phases

Production

Various levels of analysis could be required to assess impacts occurring during the production phase, since the use of capital for operations and modifications could require either local resources or resources from outside the region.

Potential impacts to medium-size and large communities from the use of local capital for modification and operation activities during production would generally be as described for GBI development and testing activities under the Preferred Action.

It is anticipated that labor and capital requirements to support the production phase in rural areas or small communities would be supplied from outside the region. Potential impacts to rural areas or small communities from in-migrants or imports associated with production activities would generally be as described for GBI development and testing activities under the Preferred Action.

Basing, Systems Maintenance, and Support Operations

The type and extent of socioeconomic impacts which could occur during the basing of BM/C3, ground-based, and space-based elements would depend on a community's economic base and capacity, labor force diversification, and the program's construction labor and capital requirements.

Potential impacts to medium-size to large communities from the use of local capital for basing, systems maintenance, and support operations activities would generally be as described for GBI development and testing activities under the Preferred Action.

Potential impacts to rural areas or small communities from in-migrants or imports associated with basing, systems maintenance, and support operations activities would generally be as described for GBI development and testing activities under the Preferred Action.

Decommissioning

Decommissioning activities could include the conversion of NMD locations into nonmilitary, retrofitting to other military uses, or closure (i.e., abandoned-in-place), potentially involving operations and demolition activities.

While decommissioning would be conducted for the BM/C3 and all ground-based and space-based elements, the primary decommissioning activities

would involve GBI and GBS sites, which could require additional labor and capital to decommission. Since the GBI and GBS sites could be located in remote, uninhabited areas or rural areas and small communities, in-migration of labor and importing capital probably would be required to demolish facilities, requiring further analysis at the time of closure.

The impacts associated with the loss of basing, system operations, and maintenance-related personnel would be dependent on the size of the community. Pending employment loss relative to community size, rural or small communities could result in socioeconomic impacts, including a loss to the economic, tax bases, and reduced demand for housing.

4.13.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.13.1.2 could be applicable to this Alternative.

4.13.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.13.3.1 Development and Testing

The types of potential socioeconomic impacts resulting from the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.13.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.13.3.2 Later Life-Cycle Phases

The types of potential socioeconomic impacts in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.13.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.13.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.13.1.2 could apply to this Alternative.

4.13.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.13.4.1 Development and Testing

The types of potential socioeconomic impacts in the development and testing life-cycle phase of this Alternative would not generally differ from

those described in Section 4.13.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.13.4.2 Later Life-Cycle Phases

The types of potential socioeconomic impacts in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.13.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.13.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.13.1.2 could apply to this Alternative.

4.14 GEOLOGY, SOILS, AND PRIME AND UNIQUE FARMLAND

Most NMD activities under the Preferred Action or under the development and testing life-cycle phase of the System Acquisition Alternatives would not involve soil surface disturbance or grading. Any necessary grading under the Preferred Action would likely be limited to areas of a few acres, and adverse impacts related to soil erosion could readily be prevented through standard erosion control practices. Basing certain ground-based elements during later life-cycle phases under the System Acquisition Alternatives could involve larger areas of grading, but standard erosion control practices should be adequate to prevent adverse erosional impacts. Impacts to prime or unique farmlands or unique geological resources would be very unlikely under the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives, and would likely take place only on a small scale under the later life-cycle phases.

4.14.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

4.14.1.1 Environmental Consequences

Soil surface disturbance and soil exposure from grading and construction attributable to NMD activities under the Preferred Action would generally be limited to tracts of a few acres within previously developed areas of existing government installations and contractor facilities. Although any prime or unique farmland or unique geological features within the area of grading would be subject to irreversible physical disturbance, the occurrence of such features in these previously developed areas is not likely. As is typical of any construction site, exposed soils would be subject to wind and water erosion and could serve as sources of fugitive dust. The small tracts of

contiguously graded lands on any single installation would limit the magnitude of these impacts to be insignificant.

Landslides and land slumping could occur if facilities were constructed in landslide-prone areas, or if construction activities were performed on steep slopes or when soils were saturated. However, construction in such areas would not be likely under the Preferred Action. Land subsidence impacts could result from groundwater withdrawal in subsidence-prone basins. However, as indicated in Section 4.8.1.1, the water requirements of most NMD activities under the Preferred Action would likely be minimal. Construction activities would not likely take place in the vicinity of mineral resource extraction activities. Flight test, test launches, and test firing activities would generally be conducted using existing facilities for which adequate restricted access areas have been established. However, it is possible that access would have to be restricted to some presently unrestricted areas, including areas with mineral resources. Access could also be restricted to prime or unique farmlands, but they would not be irreversibly damaged.

Soils could also be disturbed by the test launches of interceptors, by debris craters, and by off-road travel associated with testing. In addition, rocket exhaust could deposit contaminants on soils close to launching areas. These soil-disturbing activities would generally be localized and of short duration. Overall, they would have an insignificant impact.

4.14.1.2 Mitigation Measures

If facility construction or modification became necessary, sites could be selected to minimize restricting access to critical mineral resources. Activities involving the detonation of explosives could be adjusted to reduce impacts to the surrounding rock structure in geologically sensitive areas, such as areas of karst geology. Landslide hazards could be reduced by selecting appropriate construction sites and by implementing engineering, excavation, and construction control techniques.

Whenever practicable, soil could be allowed to dry before ground-disturbing activities were commenced. Standard engineering procedures such as shoring could be followed to minimize possible slumping in vulnerable soil groups. Static firing of rocket motors and open detonations could be conducted at sites with appropriate features, such as concrete pads, to minimize soil impacts. To mitigate the impacts from contamination from rocket exhaust or open detonation, sensitive, prime or unique soils could be avoided or larger concrete pads and/or barriers could be constructed. Soil disturbance caused by new construction could be minimized through the use of existing facilities and roads whenever possible. Off-road travel could be kept to a minimum to reduce soil compaction and dust generation.

In compliance with the Federal Soil Conservation Law (16 USC 590a) and applicable local sediment control ordinances, soil erosion and sediment control plans would be prepared for any activity involving surface soil disturbance. Erosion control methods specified in the plans could include one or more of the following, depending upon site-specific needs:

- Minimizing the area of soil disturbance, especially on steep slopes or other areas highly sensitive to soil erosion.
- Minimizing the length of time that soil remains disturbed.
- Watering exposed soil to prevent fugitive dust generation.
- Applying temporary seeding or other stabilization methods for exposed soils.
- Permanently seeding exposed soils after completion of ground-disturbing activities.
- Establishing vegetative windbreaks in areas of soil disturbance.
- Preserving of natural vegetation wherever possible between areas of exposed soils and surface waters.

In accordance with the Farmland Protection Policy Act, (7 USC 4201 et seq.) the appropriate District Conservationists from the U.S. Department of Agriculture Soil Conservation Service would be consulted as necessary to determine whether NMD activities could affect prime or unique farmlands, and all practicable efforts would be taken to avoid any impacts.

4.14.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.14.2.1 Development and Testing

Potential impacts to geology, soils, and prime and unique farmlands in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section 4.14.1.1 for the Preferred Action. There could be more construction and therefore grading activities, but areas of grading would still be generally limited in extent and concentrated primarily within already developed parts of existing government and contractor installations. Although there could be a greater number of static firings and test launches, the overall impact of these activities on surface soils should still be minimal.

4.14.2.2 Later Life-Cycle Phases

It could be necessary to grade sizable areas to base certain ground-based NMD facilities, including BM/C3 facilities, GBI farms, GBRs, and support facilities. Grading could also be necessary within rights-of-way several miles in length to install utilities or fiber-optic communications lines serving or linking ground-based facilities. Certification rounds and other ongoing flight tests, as well as launches to service space-based components, could impact nearby soils as described in Section 4.14.1.1.

Decommissioning activities would not generally involve new areas of grading or other ground disturbance, although new landfills might have to be constructed to receive demolition debris. Certain decommissioning activities such as open detonation could introduce contaminants to adjacent soils. Prime farmland excluded from cultivation to serve as buffer zones during operation of NMD facilities could be returned to cultivation following decommissioning. Lands physically disturbed during operation of NMD facilities might not be suitable for return to cultivation.

4.14.2.3 Mitigation Measures

The mitigation measures discussed in Section 4.14.1.2 could be applicable to this Alternative.

4.14.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

4.14.3.1 Development and Testing

The types of potential impacts to geology, soils, and prime and unique farmland in the development and testing life-cycle phase of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.14.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.14.3.2 Later Life-Cycle Phases

The types of potential impacts to geology, soils, and prime and unique farmland in the later life-cycle phases of the All Ground-Based System Acquisition Alternative would not generally differ from those described in Section 4.14.2.2 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, there could be substantially greater areas of surface soil disturbance because of the increased number of ground-based components. There could also be an increased potential for soil contamination and landfill construction due to decommissioning of more ground-based facilities. Conversely, there could be a reduced potential for soil contamination from rocket booster exhaust from deploying and servicing space-based elements.

4.14.3.3 Mitigation Measures

The mitigation measures discussed in Section 4.14.1.2 could be applicable to this Alternative.

4.14.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

4.14.4.1 Development and Testing

The types of potential impacts to geology, soils, and prime and unique farmland in the development and testing life-cycle phases of this Alternative would not generally differ from those described in Section 4.14.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

4.14.4.2 Later Life-Cycle Phases

The types of potential impacts to geology, soils, and prime and unique farmland in the later life-cycle phases of this Alternative would not generally differ from those described in Section 4.14.2.1 for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative. However, greater areas of surface soil disturbance and impacts to prime and unique farmlands could occur because of the increased number of GBIs. There could also be an increased potential for soil contamination and landfill construction due to the decommissioning of more GBI farms. Conversely, there could be a reduced potential for soil contamination from rocket booster exhaust from deploying and servicing SBIs.

4.14.4.3 Mitigation Measures

The mitigation measures discussed in Section 4.14.1.2 could be applicable to this Alternative.

4.15 CUMULATIVE IMPACTS

This section considers the cumulative environmental consequences from the entire BMD Program, including both NMD activities and TMD activities. As defined in the CEQ regulations (40 CFR 1508.7),

> 'cumulative impact' is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative

> impacts can result from individually minor but collectively significant actions taking place over a period of time.

The environmental consequences from NMD activities under the Preferred Action (continued Technology Readiness Program) and the System Acquisition Alternatives are assessed in Sections 4.1 through 4.14 of this PEIS. The environmental consequences from TMD activities have been addressed independently in the TMD PEIS (BMDO, 1993). Based on the TMD PEIS, a decision has been made to proceed with the acquisition of a fully integrated, comprehensive TMD system. In addition to research, development, and testing of the TMD system, reasonably foreseeable actions include production, basing, and decommissioning under the TMD Program.

Separate discussions of cumulative impacts are provided for each of the environmental topics addressed in this BMD PEIS. Chapter 3 serves as the baseline against which cumulative impacts from all sources (including NMD activities, TMD activities, and activities not part of the BMD Program) are assessed. For this assessment of cumulative impacts, the discussions have been separated into local and regional cumulative impacts, and global cumulative impacts. Local and regional cumulative impacts would be expected to affect only limited geographic areas, while global cumulative impacts could potentially affect large areas of the world.

The following discussion applies to the Preferred Action (Technology Readiness Program) and to the development and testing life-cycle phase of the System Acquisition Alternatives, as well as TMD activities. The relative magnitude of certain cumulative impacts could be somewhat greater for the System Acquisition Alternatives. The discussion is also broad enough to apply to cumulative impacts of later life-cycle phases of the System Acquisition Alternatives. The magnitude of the impacts for these later life-cycle phases could also be greater for some environmental topics.

A detailed assessment of cumulative impacts requires consideration of existing conditions at specific sites and is therefore not within the scope of this PEIS. This assessment focuses on the general character of impacts resulting from the BMD Program. The cumulative impacts of specific activities at sites with environmental concerns would be assessed as necessary in future environmental documentation.

4.15.1 LOCAL AND REGIONAL CUMULATIVE IMPACTS

Most of the cumulative impacts considered in this PEIS would be local and regional in character. Local and regional cumulative impacts are discussed for the following topics: air quality; electromagnetic radiation; hazardous materials and waste management; noise; safety; surface water and

groundwater; visual resources; cultural resources and native populations; biological resources and wetlands; land use; socioeconomics; and geology, soils, and prime and unique farmland.

Each local and regional cumulative impacts topic discussion is presented in two parts. The first part considers impacts from the BMD Program as a whole, including NMD and TMD activities. Information concerning impacts from TMD activities is based on analyses presented in the TMD Final PEIS (BMDO, 1993) and in the TMD Extended Test Range Draft EIS (USASSDC, 1994b). The second part considers impacts from the entire BMD Program together with impacts from sources outside the BMD Program.

4.15.1.1 Air Quality

Due to the brief, sporadic frequency of atmospheric emissions associated with BMD activities, no substantial short- or long-term air quality impacts are expected. Potential impacts on air quality from NMD activities under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would include emissions from construction activities, power generation, hazardous propellants, rocket exhaust, and hazardous industrial solvents, as well as emissions caused by human activities (e.g., transportation). Impacts from development and testing of the TMD Program would include rocket exhaust, air emissions from systems testing and industrial processes, vehicle emissions, and fugitive dust (BMDO, 1993). Impacts from later life-cycle phases of the TMD Program could include emissions from industrial processes, vehicle emissions and fugitive dust, and emissions from decommissioning activities.

The potential cumulative impacts to air quality of BMD activities combined with other sources outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include emissions associated with local and regional growth, industrial activities and non-BMD launch and flight activities. Potential cumulative air quality impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.2 Electromagnetic Radiation

Potential cumulative EMR impacts of BMD activities are expected to be minimal. BMD sources of high-frequency EMR would generally be localized and would typically only transmit for brief burst periods. Incremental addition of low-frequency EMR from BMD power and communications system would be small in most areas. Potential impacts from EMR created by NMD activities under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would include incremental human and wildlife exposure to high-frequency EMR from radars and guidance systems, and incremental low-frequency EMR from power and

communication systems. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could include exposure to EMR from component testing, use of radar, power transmission lines, and potential electromagnetic pulse testing (BMDO, 1993).

The potential cumulative impacts from EMR created by BMD activities combined with sources outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include electric transmission and distribution lines, communication systems, and other radar systems. Potential cumulative EMR impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.3 Hazardous Materials and Waste Management

Waste minimization, centralization of responsibility for hazardous materials, disposal planning, and compliance with laws and regulations would limit potential cumulative impacts from BMD activities. For example, the Federal Facility Compliance Act (42 USC 6901 et seq.) ensures that Federal facilities generating or storing hazardous waste comply with state hazardous waste programs. Potential impacts relating to hazardous materials and waste management from NMD activities under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives are associated with handling, storage, transportation, and disposal of hazardous materials and wastes. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could result from the increased use of hazardous materials for production, testing, and decommissioning (BMDO, 1993). There could also be generation of hazardous wastes by all life-cycle activities.

The potential cumulative impacts of hazardous materials and waste management from BMD activities combined with sources outside the program are not possible to assess until specific sites are selected. Other sources of impacts could include industrial and government hazardous materials and waste management activities. Potential cumulative hazardous materials and waste management impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.4 Noise

BMD Program activities would involve some new construction. Activities would be limited in duration and small in scale. Rocket launches and flight tests associated with BMD activities would primarily be performed at facilities with a history of similar activities. Therefore, the cumulative impacts of the BMD program are expected to be minimal. Potential noise impacts from NMD activities under either the Preferred Action or the

development and testing life-cycle phase of the System Acquisition Alternatives would include noise from missile launches, flights, and static firing tests; power generation; sonic booms; construction; and traffic. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could include noise from launching, static firing, power generation, explosive testing, traffic, facility modification and construction, and sonic booms (BMDO, 1993).

The potential cumulative noise impacts from BMD activities combined with sources of impacts outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include launches from other programs, as well as increased local and regional human and industrial activity. Potential cumulative noise impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.5 Safety

The implementation of safeguards, safety plans for launch operations, and procedures which address handling, transportation, fueling, and disposing of propellants, and delineation of ground hazard areas at BMD related facilities would limit potential cumulative impacts from BMD activities. Potential impacts from NMD activities on safety concerns under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would consist of occupational and public exposure to toxic, hazardous materials, or physical hazards. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could include worker safety during lethality research, missile development, prototype manufacturing processes, system transportation, toxic materials during assembly operations, flight tests, and during ground testing of radars and seekers (BMDO, 1993). Potential impacts from later life-cycle phases of the TMD Program could include occupational and public exposure during mass manufacturing processes, toxic materials during assembly operations, system transportation, and storage of TMD systems.

The potential cumulative impacts from BMD activities combined with other sources of outside the BMD Program to worker and public on safety are not possible to assess until specific sites are selected. Other sources of impacts could include industrial or government manufacturing and flight activity. Potential cumulative safety impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.6 Surface Water and Groundwater

Potential cumulative impacts from the BMD program on water quality and water quantity are expected to be minimal. Inadvertent or accidental

contamination of water resources due to spills, runoff, or sedimentation from BMD activities could be effectively prevented by routine precautions. Surface water in the immediate vicinity of existing launch facilities could be exposed to exhaust clouds from launch and static firing activities and experience some acidification effects. Wastewater discharges would be discharged to existing publicly or federally owned treatment works, and water consumption would remain at or near current levels. Potential impacts to water resources from NMD activities under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would generally be limited to localized and temporary surface water quality impacts related to launch exhaust clouds and falling rocket debris. Potential impacts from the development and testing and later life-cycle phases of the TMD Program on water quality could include adding sediment or pollutants to surface waters during construction activities, release of hazardous or toxic substances, settling of air pollutants onto surface waters during test missile firing and during decommissioning of missiles, accidental spills or releases during transport or transfer of TMD materials or near-surface rocket or aircraft accidents, and saltwater intrusion from groundwater usage in some regions (BMDO, 1993). Potential impacts to water quantity from TMD Programs could include increased drinking and process needs during production operations, and decommissioning operations.

Assessment of potential cumulative impacts from BMD activities combined with other sources outside the BMD Program related to surface water and groundwater are not possible until specific sites are selected. Other sources of impacts would be associated with increased local and regional human and industrial activity. Potential cumulative surface water and groundwater impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.7 Visual Resources

The potential cumulative impacts of BMD activities or visual resources are expected to be minimal. BMD activities would involve some new construction that when possible would remain within areas previously disturbed. Rocket launches and flight tests would primarily be performed at facilities with a history of similar activities. Potential impacts from NMD activities on visual resources under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would be associated with testing activities and the construction of new facilities. Potential impacts from the development and testing life-cycle of the TMD Program could occur during flight tests, and facility construction and modifications (BMDO, 1993). Impacts from later life-cycle phases of the TMD Program would occur during decommissioning of rocket motors.

The potential cumulative impacts on visual resources from BMD activities combined with other sources outside the BMD Program of impacts are not possible to assess until specific sites are selected. Other sources of impacts could include new construction associated with population growth, and changes in land use patterns. Potential cumulative visual resources impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.8 Cultural Resources and Native Populations

The potential cumulative impacts to cultural resources and native populations of BMD activities are expected to be minimal. BMD activities would involve some new construction, appropriate preconstruction studies would be completed before any construction starts, and rocket launches and flight tests under both programs would primarily be performed at facilities with a history of similar activities. Potential impacts from NMD activities on cultural resources and native populations under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives generally would result from construction, noise from rocket launches and flights, and air pollutants. Impacts from the development and testing and later life-cycle phases of the TMD Program could include impacts that might occur as a result of noise, vibration, or pollution from outdoor test activities, ground disturbance of cultural resources, or disturbances of Native American religious or other cultural activities (BMDO, 1993).

The potential cumulative impacts on cultural resources and native populations from BMD activities combined with other sources outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include new construction associated with industrial activity and population growth. Potential cumulative cultural resources and native populations impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.9 Biological Resources and Wetlands

The potential cumulative impacts on biological resources and wetlands of the BMD program are expected to be minimal. EMR beams associated with BMD activities would be highly localized at a small number of facilities, or installations. Therefore, potential impacts on airborne wildlife are expected to be minimal. BMD activities would involve some new construction. Rocket launches, and flight tests that would primarily be performed at facilities with a history of similar activities. Potential impacts from NMD activities to biological resources and wetlands under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would generally be limited to small areas of habitat loss, primarily within existing Government installations and contractor

facilities, and include brief episodes of noise generation, and exposure of airborne wildlife to EMR. Impacts from the development and testing and later life-cycle phases of the TMD Program could include adverse effects on wildlife habitats, and encroachment on sensitive habitats, wetlands, or floodplains (BMDO, 1993).

Assessment of the potential cumulative impacts to biological resources and wetlands from BMD activities combined with other sources outside the BMD Program are not possible until specific sites are selected. Other sources of impacts could include new construction associated with human and industrial activities, agricultural development, and forestry. Potential cumulative biological resources and wetlands impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.10 Land Use

The potential cumulative impacts to land use of BMD activities are expected to be minimal. BMD activities would involve some new construction that when possible would remain within areas previously disturbed. All development would comply with appropriate land use regulations. Rocket launches and flight tests would primarily be performed at facilities with a history of similar activities. Potential impacts from NMD activities to land use under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would include facility modification and land use restriction due to testing activities. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could include modifications of facilities, increased production (e.g. increased restricted areas), and restriction on land use due to testing or basing activities (BMDO, 1993).

The potential cumulative impacts to land use of BMD activities combined with other sources outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include new construction associated with population growth and increases industrial activities. Potential cumulative land use impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.11 Socioeconomics

The potential cumulative impacts of BMD activities on socioeconomics are expected to be minimal. BMD activities would not involve large workforce changes or public service effects. However, BMD activities in small communities may have adverse impacts. Potential impacts from NMD activities to socioeconomics under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition

Alternatives include impacts to employment, population, housing demand, and income. After an initial growth period, secondary impacts may include increased demand for public utilities and services. These types of impacts may be more pronounced in rural areas that are less likely to have the resources available to meet increased demands. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could include adverse socioeconomics impacts on housing, infrastructure, public services, and finance impacts in small vulnerable communities due to full-scale production of TMD (BMDO, 1993).

The potential cumulative impacts to socioeconomics of BMD activities combined with other sources of impacts outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include new commercial, industrial, and government activities. Potential cumulative socioeconomics impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.1.12 Geology, Soils, and Prime and Unique Farmland

The potential cumulative impacts to geology, soils, and prime and unique farmland of BMD activities are expected to be minimal. BMD activities would involve some new construction, and rocket launches and flight tests would primarily be performed at facilities with a history of similar activities. Communication with local agencies prior to construction and operations, erosion control measures, and reclaiming and reseeding translocated soils could further minimize potential geological and soil impacts from BMD activities. Potential impacts from NMD activities to geology, soils, and prime and unique farmland under either the Preferred Action or the development and testing life-cycle phase of the System Acquisition Alternatives would generally be limited to impacts from new construction. Potential impacts from the development and testing and later life-cycle phases of the TMD Program could include restrictions on access to mineral or energy resources, soil erosion or blast effects, losses of prime and unique farmland, and land subsidence from water use (BMDO, 1993).

The potential cumulative impacts to geology, soils, and prime and unique farmland of BMD activities combined with other sources outside the BMD Program are not possible to assess until specific sites are selected. Other sources of impacts could include new construction associated with industrial activity and population growth. Potential cumulative geology, soils, and prime and unique farmland impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.2 GLOBAL CUMULATIVE IMPACTS

Potential cumulative impacts associated with stratospheric ozone depletion, global climate change, and biodiversity are global rather than local or regional in character. These issues and associated impacts have been identified by the Council on Environmental Quality (CEQ) as important global concerns (CEQ, 1993).

4.15.2.1 Stratospheric Ozone Depletion

The stratospheric ozone layer protects the surface of the earth from levels of excess solar radiation associated with ultraviolet light which causes an ecological damage, including crop and plant life damage, and increased incidence of skin cancer and cataracts. Under the BMD Program, small quantities of ozone-depleting gases (CFCs and other compounds) would be released to the atmosphere. These releases are a very small proportion of releases worldwide but would nonetheless cause further ozone depletion and potential increased incidence of solar radiation-related health and ecological damage. Atmospheric modeling has shown that worldwide rocket launches show no significant global impacts on the ozone layer (Harwood et al., 1991). Therefore, no significant increase in human health and ecological damage is expected from BMD activities. Once suitable alternatives have been identified and are made commercially available, they would be utilized by the BMD Program. Until alternatives are substituted, CFCs would be used by the Program until phased out by regulation. Appropriate mitigation measures would limit the release of ozone-depleting substances to the atmosphere. Potential cumulative stratospheric ozone depletion impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.2.2 Global Climate Change

Rising emissions of greenhouse gases are hypothesized to increase global temperatures and therefore cause global climate change. Under the BMD Program, small quantities of greenhouse gases would be released to the atmosphere. These releases would be a very small proportion of releases worldwide, but would nonetheless result in a net increase in global greenhouse gas emission. If regulations regarding greenhouse gas releases become more stringent, BMD operations would be made to comply with the amended regulations. Potential cumulative global climate change impacts of the BMD Program and other sources are not expected to be significant and will be within all applicable regulations.

4.15.2.3 Biodiversity

Biodiversity encompasses the variety and the genetic variability of species and the variety of the ecosystems they inhabit. The loss of biodiversity

could be caused by a number of factors including habitat loss and fragmentation, over-exploitation of species, introduction of intrusive species into an ecosystem, pollution, and climate change. The loss of biodiversity represents the possible loss of ecological, economic, and aesthetic benefits. Under the BMD Program, disruption of biota and habitats would occur. Recommendations on mitigation measures would be prepared after biological assessments are made in support of future environmental documentation. Potential cumulative impacts to biodiversity from the BMD Program and other sources are not expected to be significant and will be within all applicable regulations, such as the Threatened and Endangered Species Act, the Fish and Wildlife Coordination Act, and other applicable statutes.

4.16 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Potential irreversible and irretrievable commitments identified for BMD Program activities, including the NMD activities assessed in this PEIS and the TMD activities assessed in an earlier PEIS (BMDO, 1993), include cultural resources, materials, energy, land, and human resources.

4.16.1 CULTURAL RESOURCES

If damage or destruction of cultural resources could not be avoided, the decision would constitute irretrievable commitments of these resources. BMD activities would be planned to avoid, to the greatest extent possible, any damage or destruction to cultural resources. To mitigate the loss of these resources, appropriate preconstruction studies would be conducted before ground-breaking activities take place, and physical evidence and data would be recovered to be preserved as a permanent record.

4.16.2 MATERIALS

Production of components and construction of facilities for the BMD Program would require the use of different materials. Ordinary machining and electrical materials (e.g., aluminum, copper, plastic) would be necessary for the production of BMD Program components. These materials would be recycled or destroyed as components are removed from operation. Test missile and target debris would not be fully recoverable. In the future, the recovery of satellites for recycling of components and materials may be viable; however, at this time there are no feasible recovery plans. Strategic and critical materials (e.g., beryllium, cadmium, cobalt) would also be necessary for the production of BMD Program components, but are not expected to be required in sufficient quantities to seriously reduce the national or world supply. These materials may also be recycled or destroyed as components are removed from operation. Ordinary materials (e.g., wood, cement, sand, gravel, plastic, steel, and aluminum) would be necessary for the construction of facilities to house program activities. These materials, except for those that would be recycled, would be irreversibly consumed.

The ordinary materials to be used in either production or construction are not considered in limited supply.

4.16.3 ENERGY

Energy would be consumed during all BMD activities. Coal, natural gas, and propane would be consumed for power production. Diesel fuel, gasoline, and oil would be used for transportation vehicles. Rocket propellants would also be consumed during tests and launches.

4.16.4 LAND

Land that would be used for BMD-related activities is not irretrievable; however, it could be of limited availability to other purposes during the life of the Program. Many of the sites could be returned to their former uses or utilized for other purposes upon the completion of BMD activities. Facilities could be used for other defense or industrial purposes or returned to open land. However, soil mixing and compaction caused by ground-disturbing activities could permanently render sites unsuitable for certain agricultural and horticultural uses. Remediation activities could be required as a result of some BMD activities.

4.16.5 HUMAN RESOURCES

Human resources used for all BMD activities would be irretrievably lost since these resources would be unavailable for use in other work activity areas. However, technological and scientific advances resulting from BMD-related activities could decrease the lost opportunity associated with this diversion of resources.

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Chapter 5

Consultation and Coordination

5.0 CONSULTATION AND COORDINATION

The federal agencies that were contacted during the course of preparing this programmatic environmental impact statement are listed below.

FEDERAL AGENCIES

National Aeronautics and Space Administration
United States Air Force
United States Army
United States Department of Energy
United States Department of the Interior
United States Environmental Protection Agency
United States Navy

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B.A., 1983, Environmental Studies, State University of New York at Binghamton, Binghamton, New York
M.A., 1985, Public Administration and Public Policy Analysis, State University of New York at Binghamton, New York
Years Experience: 8

Donald C. Habib, Engineer, Halliburton NUS Corporation
B.S., 1982, Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts
Years Experience: 12

Mark H. Hall, Land Use Planner, Halliburton NUS Corporation
B.E.D., 1987, Environmental Design/Architecture, Texas A&M University, College Station, Texas
C.U.D., 1990, Urban Design, University of Pennsylvania, Philadelphia, Pennsylvania
M.C.P., 1990, City Planning, University of Pennsylvania, Philadelphia, Pennsylvania
Years Experience: 4

Scott A. Hartford, P.E., Captain, U.S. Air Force, Engineer, HQ AFCEE/ECA
B.S.C.E., 1986, Civil Engineering, University of New Hampshire, Durham, New Hampshire
M.B.A., 1990, Management, Golden Gate University, San Fancisco, California
M.S., 1991, Environmental Engineering, University of Colorado, Boulder, Colorado
Years Experience: 7

Kerry P. Humphrey, Environmental Scientist, Halliburton NUS Corporation
B.S., 1984, Biology, Indiana University, Bloomington, Indiana
M.S., 1988, Biology, University of Louisville, Louisville, Kentucky
Years Experience: 10

Merance Jacaruso, Technical Specialist, Halliburton NUS Corporation
B.S., May, 1994, Degree Candidate in Chemical Engineering, University of Maryland, College Park, Maryland
Years Experience: 1

Timothy J. Knapp, U.S. Air Force, Planner, HQ AFCEE/ECP
B.S., 1967, Environmental Resource Management, California State University, Sacramento, California
Years Experience: 27

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B.S., 1979, Chemistry, McGill University, Montreal, Quebec, Canada
M.S., 1982, Physical Chemistry, University of Miami, Coral Gables, Florida
Ph.D., 1986, Physical Chemistry, Dartmouth College, Hanover, New Hampshire
Years Experience: 8

James M. MacConnell, Environmental Specialist, Halliburton NUS Corporation
B.S., 1974, Zoology, University of Maryland, College Park, Maryland
Years Experience: 20

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B.S., 1965, Dickinson College, Carlisle, Pennsylvania
M.S., 1972 Purdue University, West Lafayette, Indiana
Years Experience: 29

Warren G. Martin, General Engineer, U.S. Army, Program Executive Office, Missile Defense
B.S., 1961, Civil Engineering, Auburn University, Auburn, Alabama
Years Experience: 33

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B.A., 1978, Anthropology, Franklin and Marshall College, Lancaster, Pennsylvania
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Years Experience: 16

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Ph.D., 1973, Biology/Aquatic Ecology, University of Notre Dame, Notre Dame, Indiana
Postdoctoral Studies, 1973-1974, Civil Engineering, University of Notre Dame, Notre Dame, Indiana
Years Experience: 21

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B.C.E., 1973, Civil Engineering, Georgia Institute of Technology, Atlanta, Georgia
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Years Experience: 21

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Years Experience: 16

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Years Experience: 7

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B.S., 1965, Civil Engineering, University of Washington, Seattle, Washington
Years Experience: 29

Linda S. Robinson, Community Relations Specialist, Halliburton NUS Corporation
B.S., 1971, Earth Sciences, Texas Christian University, Fort Worth, Texas
M.B.A., 1987, Loyola College, Baltimore, Maryland
Years Experience: 23

John G. Ruff, Land Use Planner, Halliburton NUS Corporation
B.A., 1987, Political Science, James Madison University, Harrisonburg, Virginia
M.P., 1992, Urban and Environmental Planning, University of Virginia, Charlottesville, Virginia
Years Experience: 4

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M.S., 1984, Public Administration, San Diego State University, San Diego, California
Years Experience: 10

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M.S., 1969, Zoology, University of Cincinnati, Cincinnati, Ohio
Ph.D., 1974, Wildlife Management, Michigan State University, East Lansing, Michigan
Years Experience: 22

Timothy J. Schott, Meteorologist, Halliburton NUS Corporation
B.S., 1985, Meteorology, City College of New York, New York, New York
Years Experience: 9

W. Christopher Schwartz, Economist, Halliburton NUS Corporation
B.A., 1991, Economics, Kenyon College, Gambier, Ohio
Years Experience: 3

N. Russell Scott, U.S. Air Force, Wildlife Biologist, HQ AFCEE/ECP
B.S., 1964, Political Science, Southwest Texas State University, San Marcos, Texas
Years Experience: 30

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B.A., 1989, Biology, University of North Carolina, Chapel Hill, North Carolina
Years Experience: 5

Michael Septoff, Meteorologist, Halliburton NUS Corporation
B.S., 1966, Meteorology/Oceanography, City College of New York, New York, New York
M.S., 1968, Meteorology/Oceanography, New York University, New York, New York
Year Experience: 26

Hazel C. Slemmons, Environmental Analyst, Halliburton NUS Corporation
B.S., 1986, Business Administration, University of Maryland, College Park, Maryland
Years Experience: 8

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B.S., 1972, Landscape Architecture, Michigan State University, East Lansing, Michigan
M.L.A., 1973, Landscape Architecture, University of Illinois, Urbana, Illinois
Years Experience: 22

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B.S., 1989, Environmental Studies, State University of New York College of Environmental Science and Forestry and Syracuse University, Syracuse, New York
Years Experience: 5

Michael J. Trowse, General Engineer, U.S. Army, Program Executive Office, Missile Defense
B.S., 1972, Industrial Engineering, New Mexico State University, Las Cruces, New Mexico
Years Experience: 22

James G. Van Ness, Lieutenant Colonel, U.S. Air Force, Attorney, HQ AFCEE/JA
B.S., 1971, Distributed Studies, Iowa State University, Ames, Iowa
J.D., 1974, University of Iowa Law School, Iowa City, Iowa
LL.M., 1984, Law and Marine Affairs, University of Washington School of Law, Seattle, Washington
Years Experience: 23

Steve M. Varner, Engineer, Halliburton NUS Corporation
B.S., 1987, Civil Engineering, Virginia Polytechnic Institute State University, Blacksburg, Virginia
M. Arch., 1991, Architecture, Virginia Polytechnic Institute State University, Blacksburg, Virginia
Years Experience: 3

Tammy L. Way, Community Relations Specialist, Halliburton NUS Corporation
B.A., 1989, Political Science, Virginia Polytechnic Institute State University, Blacksburg, Virginia
Years Experience: 5

Robert H. Werth, Physicist, Halliburton NUS Corporation
B.A., 1973, Physics, Gordon College, Wenham, Massachusetts
Years Experience: 21

Chapter 7

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Chapter 8

Public Comments and Responses

8.0 PUBLIC COMMENTS AND RESPONSES

This chapter presents all public comments and responses to the Ballistic Missile Defense (BMD) Draft Programmatic Environmental Impact Statement (DPEIS) which have been incorporated into the Final Programmatic Environmental Impact Statement.

8.1 INTRODUCTION

The Ballistic Missile Defense Organization (BMDO) has complied with the National Environmental Policy Act (NEPA) mandate of public participation in the environmental impact analysis process primarily in the following ways:

- The scoping process began on February 4, 1992 and ended on March 6, 1992, with public hearings held in Washington, D.C., and Los Angeles, California, on February 25 and February 27, 1992, respectively.

- The DPEIS was made available for public review and comment from April 15 through May 31, 1994.

- Public hearings were held in Santa Barbara, California on May 10, 1994 and in Washington, D.C. on May 12, 1994.

An advertisement about the public hearings appeared in both national and regional newspapers. The advertisement appeared in *USA Today, the LA Times, and the Washington Post* prior to the hearings. Public service announcements were submitted to both Los Angeles, California and Washington, D.C. areas on two separate occasions. Press conferences were also held in both cities. A copy of the Notice of Availability (NOA) was mailed along with the DPEIS document to all those who expressed an interest in receiving information on the program. The NOA offered an invitation to provide comments within the specified comment period dates; announced hearing locations, dates, times; listed the comment mailing address; and identified a toll-free 800 number for both verbal and hearing impaired comments/requests.

Public comments received verbally at the public hearings, in writing, or by toll-free 800-line telecommunications (voice, facsimiles, and hearing impaired) during the public response period have been reviewed and are addressed in this chapter.

Documents received which were outside the scope of or not relevant to the BMD Program have not been included in this chapter. However, they are part of the administrative record and are available to the public upon

request. Also, for lengthy submittals, only the pages containing comments are included in Section 8.2.2.

8.2 ORGANIZATION

8.2.1 LIST OF COMMENTORS/REQUESTORS

In reply to the request for public comments, 25 individuals from 11 states, the District of Columbia, and the Province of Quebec responded with comments within the scope of this Programmatic Environmental Impact Statement (PEIS). A total of 13 organizations responded, including 7 states, 2 universities, 3 federal offices, and 1 private organization. Table 8-1 lists by document number, individuals and organizations that provided comments followed by those requesting documents or BMD program information.

8.2.2 COPIES OF COMMENT SUBMITTALS

Exhibit 8-1, beginning on the following page, contains copies of the comment documents received (letters, postcards, 800-line telephone calls and facsimiles, and transcripts) organized by "Document Number," with the 3-digit comment number on each page of each document.

8.2.3 RESPONSES TO COMMENTS

This section contains the responses to commentors listed in Table 8-1, which follows Exhibit 8-1. Each "Document Number" in the table corresponds with the document and 3-digit comment number in this section. The text of the PEIS has been revised, as appropriate, to reflect the concerns expressed in the public comments.

0001.001 Congress appropriates money for funding of all federal projects. Discussion of alternative uses of government funds is outside the scope of this PEIS.

0001.002 Consideration of the development of the BMD System, in concert with allies of the United States, is outside the scope of this PEIS. However, we recognize it is desirable to include our allies to the extent possible and are doing so.

0002.001 Comment noted.

0004.001 See response number 0001.001.

0005.001 Comment noted. Requested information has been provided.

EXHIBIT 8-1
COMMENT DOCUMENTS

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Document 0001

BMDO Comment Response Line

Date: 5/3/94

Hello, my name is Peter Bangina, 102 Calle Balboa, San Clemente, CA 92672. And
judging from the kind of abstract description in the paper, it appears that the plan is to
develop a ballistic missile system for protecting against missiles coming in. And my
comment is is that past systems have proven to be extremely expensive, I think that
001 money could be much better spent purchasing Soviet weapons, stopping the
proliferation of nuclear and other weapons. And also in light of the recent retargeting
of the Soviet missiles, it seems kind of pointless to develop this system, especially on
a unilateral basis for such an expensive system, if we were to do it, and if we can do it
in an environmentally sound way which I question, then I think we should bring other
002 allies in with us, who would, it would be in their interest too, much like we're shipping
PATRIOT missiles over to South Korea to help protect them, even though the
PATRIOT, is only minimally affective, it still is something that other countries may have
an interest in them. And perhaps on a U.N. basis. But I do not think it's something that
the United States should develop unilaterally. I do not think that we should be
spending the money on it, and I am concerned about the environmental impact. We
have TRW behind us in San Clemente, they use hazardous chemicals as use an area
which has work back on from, has been probably irreparably damaged by the work

1 of 2

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Document 0001

BMDO Comment Response Line

they've done, at least from an environmental standpoint for the national habitat, and
the use of lazers and other expensive equipment, is something that I think we have
better uses for our money. I would appreciate a synopsis, not a 2 inch thick
environmental report, I don't have the point to read it, but something that would go
into maybe a few pages that would cover what kind of impact this would have, both
001 environmentally and economically hopefully taxpayers money won't be wasted on
another military boondoggle, much like what was proposed on the Star Wars program
during the Reagan administration. Thank you, and my phone number is 714-492-1938.
Bye.

2 of 2

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Document 0002

BMDO Comment Response Line

Date: 5/3/94

My name is Professor Mark Freeman, my address is 338 N. Harvard Ave, Clairmont,
CA 91711. It's unrealistic to consider the environmental impact or the Ballistic Defense
System without putting in the context of the of use of such systems and the likelihood
001 that they would increase with those nuclear war which of course, would devastate the
environment. I strongly urge that research and development of Ballistic Missile Defense
Systems be halted. Thank you very much. Bye-bye.

1 of 1

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Document 0004

BMDO Comment Response Line

Date: 5/4/94

My name is Joseph Sheffman, 4 Washington St in Aslin, New Hampshire, I would
definitely like a copy of the information sent to me, my comment is we spend alot of
money in this country on our defense and on our military and we can't balance our
001 budget and we can't send our children to bed at night with food in their stomach's. It's
time to spend less money on arms and the military and more money on people. Thank
you very much.

1 of 1

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Document 0005

May 1, 1994

Dear Major Bailey,

Upon seeing the ad by BMDO in

001 U.S.A. To-day newspaper 4/30/90 I am writing to support your BMD program and ask for any information you can send me about ~~Jour~~ your program will actually save both our country and the U.S.A. taxpayers money –

Sincerely,

Bill Riggin, Retired State Senator

4672 Cotton Dr #10

Memphis, Tenn. 38118

Document 0006

GABRIEL MEMBIELA
782 NW 42 AVENUE
SUITE: 534
MIAMI, FLA 33126

April 29, 1994

Major Tracy Bailey,
B.M.D.O.
P.O. Box 4140
Gaithersburg, MD.,
20885-4140

Major Bailey/B.M.D.O., as per your press release in USA-TODAY of this date April 29,1994. I am writing you to comment on the topic in question of the environmental impact of the Ballistic Missile Defense system you and your organization are working on. As a on again and off again part time aerospace engineering student and a real space and hitech "weopons systems", "Buff" or should a say interested fan of these programs. I have a little notion of what the system is all about.

001 I, have already made a comment as of this date on you 1-800 number. But Major, if this a well run and thought trough program, then their should be not even minor impact damage on the environment. Take the case of the U.S. AirForce (S.A.C.) being a good neighbor all thses decades of the cold war, the extream of the wildlife preserves around the K.S.C., Cape Canaveral and Patrick AirForce base complex in central Florida. Were not only do they co-exsist ,but each appears to bennefit from the presssence of the other. Or to another extream the U.S.NAVYS ballistic and attack submarines. Powered by a potential catastrophic power supply that may never be totally safe (until fussions avaliable ofcourse) Yet they have an operational and environmental record that may be as near perfection as fission may ever get.

But these technological to environment success were because of the well run and well thought of day to day operations. Your program that can bring safety to billions and replace the old early sixties saying" Democracy's Silent Sentinals", this used to refer to I.C.B.M.s But this could also be applicable to a defense systems of the 21st centrury, were the key is interception not retaliation, ALL this valued project need is some one with an iron fist to keep erveryting in order not a deskbound wonder who planning his beaucratic bumbling, some one like the daring and carismatic Gen. Curtess Lemay USAF (RET) and or the resourcesfull and creative Admrl. Hyram Rickover USN (RET) , One the father if SAC and the other the nuclear navy.

Document 0006

In conclussion Major Bailey, if everything is run well and by the good old book, the environment should not be harmed. Aswell as developing a program based on prevention and protection not on assured massive retaliation,(the threat of massive retalitation did its job in its time, but now our old targets are being dismantled and our old enemies are now our freinds and bussiness partners, and if somthing is launched in anger there is no longer a clear target for retaliation,the list of potential enemies with ballistic capabilities is huge , so an system of ballistic defense from multiple treats does point the way to a defense system in the so called new world order.),But. I, repeat non of the hardeware that needs to de developed and tested should harm the environemt, why build a fence if it only burns doen the house?.

Respectfully yours

Gabriel Membiela

Gabriel Membiela

Document 0007

BMDO Comment Response Line

Date: 5/5/94

My name is Gabriel Membiela my wife's address is 782 Northwest 42nd Avenue, Suite 534, Miami Florida, the zip is 32126. I'm calling about today, Friday, the Friday April 29th, the article on your press release in the USA today paper, I had to call 'cause I'm

001 an on again off again aerospace engineering student, in space program, I'm behind your program 100%, and as to the programmatic environmental impact statement, I don't see why your project should do any significant damage or should be any significant environmental problem with your program or the testing or the equipment, whether it be the or the nuclear technology or non-nuclear technology or whatever, I don't see why your program or any, any enemy of your program should be if properly run and taken care of, should prove any problem with the environment or the nearby areas, so go for it guys, thank you and thanks for expressing myself on this because I've been behind your program for a long time, and just like the naval reactors, if there's someone keeping an eye on them, like good ole Rickover there's nothing going to go wrong and there's things that's gonna go right. But if you get someone who's a paper pusher behind them, of course everythings gonna go wrong.

1 of 2

RPBarr

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Document 0007

BMDO Comment Response Line

So if you gotta bring somebody who's keeping their eye on everything, when all the nuclear technology and hardware that they're gonna be using will be used from I don't know, from hypographic fuel to maybe nuclear whatever, so so long as someone's keeping an eye on the thing, I don't think your problem should be.....I think this is even a waste of time because they should have not have anything to do with the environment. Because it's of such a low impact it's capable of producing. Once again my name's Gabrielle Mandella from Miami, my address is 782 Northwest 42nd Ave, Suite 534, Miami Florida, 32126, and thanks for giving me a chance to express myself. I'm also sending a letter which will detail a little bit more of my comments. Thank you.

2 of 2

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Document 0008

BMDO Comment Response Line

Date: 5/5/94

Please send written information to Mr. Paul Foer, address is 921 Boucher Ave., that's Annapolis, MD 21403. Please tell me what the Ballistic Missile Defense Organization is. Please explain to me other than the fact that you're trying to adhere to various rules and regulations for public input, what the meaning of your crypto-press release that
001 appeared on May 1st in the Washington Post was all about. I don't understand who your organization is, what you're doing, what your asking for, who you're chartered by or organized by, and I would like you to send that information in writing to me as soon as possible. Thank you, bye.

1 of 1

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Document 0009

BMDO Comment Response Line

Date: 5/5/94

Jeffrey Roeder, 10901 Whipple Street, Apt. #8, N. Hollywood, CA 91602. Regarding the BMD System capability policy, I think it's great! Go for it! Develop that little puppy. Make sure though that you get all the system bugs out first because I would hate to have something of that capability land in my background if I weren't being around
001 them surrounded. Go ahead, pull in your top people from corporations such as Martin Marietta, Raytheon, these people are of high morale standards and intelligence. I fully support this effort to make my greatest country on the planet of the earth, safe, that being America, and hope that there may be something that I could do in the future to forward such an action. Thank you. God Bless America. Good-bye.

1 of 1

This is a true copy of a voice recording. 5/6/94 RALPH P. BARR, JR, Notary Public, Howard Co., MD MY COMMISSION EXPIRES 9/1/95

Document 0012

May 3, 1994
1?325 [illegible]
Reseda Ca. 91335
(818)344-9970

Major Tracy Bailey
BMDO
P.O. Box 4140
Gaithersburg MD 20?85-4140

Sir:

My observation is rather simple. An enormous amount of money, time .. and stability is required for any government to create or pursue an offensive missle system which BMDO proposes to develop a system to defeat. In this post cold war era, should any state..or quasi-state wish to launch a nuclear offensive against the U.S. (or allies) it is unlikely to spend billions for this delivery system when a much simplier one exists..which even a small country
001 could easily afford..from petty cash.

I refer, of course, to the world container fleet. The rent for a container is rather minimal and wheither the devise is set off by timer or upon being opened the danger from this delivery method far exceeds that of delivery by missle, and much more likely of reaching its target.

While free trade does have its risks, I believe it is one we will and indeed must run. Do you have any suggestions on how our government should meet this challenge to .. cold war thinking ?

Sincerely,

Robert S. Bennett

Document 0013

BMDO Comment Response Line

5/11/94

Good Afternoon, I'm Bennett Rutledge, 4318 Cedar Lake Court, Alexandria, VA 22309-1202. Basically, the Environmental Impact that I see as most important is, that the BMDO Project would have is, cutting down the number of radioactive craters that the North Koreans for example, can scatter around the planet. I'd say that's a pretty substantial impact on the environment. But even if the critics are right, and they're not able to make any difference at all about that, one of the other things that's going to come out of having low cost access to space, which is being developed for this
001 project, is not only to have Ballistic Missile Defense equipment up there, but also make it easier to get people up there, and the more people, the lower down the totem pole, maybe even ordinary government workers, that are able to look at the earth from the outside and see how fragile, how all alone in the universe it is, would make least as much of an impact on the environment as the photograph of the look of earth that was taken by the Apollo astronauts almost 25 years ago. And the impact of seeing it with your own eyes, is considerably more than a photograph, however impressive. That's what I see as the Environmental Impact of the BMDO Project. Thank you.

1 of 1

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Document 0016

BMDO Comment Response Line

5/12/94

(NO NAME-MALE)

...in D.C., I think the BMD, the BMDO is the biggest waste of money ever. And it's just proposed by a bunch of scientists who want funding for their pet projects like laser
001 research and the recent mapping of the moon. And I think that's what it's all about. And I think we should get rid of it and may use the money better things. That's it. Bye.

1 of 1

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Document 0017

BMDO Comment Response Line

5/12/94

Hello, my name is Philip Brady. I live at 1709 Dublin Drive, in Silver Spring MD, 20902, and I would like a copy of the statement or whatever statements you are giving out to the public. My comment is that I do believe we need a Ballistic Missile Defense capability in this country, and I am environmentally sensitive, I like to be. I do not you know, I do not like some of the things going on with this country such as overdevelopment with housing and everything else, but I do hope you guys are successful in employing the system. I know something about the Nights Hercules, Ajax systems and boomerang systems that were developed in the 50's. And it's seems that
001 this country can't get it back together sometimes in deploying new technologies and systems, and I hope you are successful, and I wish you good luck, and you know, just like they wanted 200 MX missiles, they put it down to 50, ya know, things get over budget and everything else, but the case can be made that we don't have any intermediate range theater missiles. We got rid of our Pershings when the Soviets got rid of their SS 20's, now my point is, alot of other countries have these missiles and we gave ours away, even though we may have some others that may somewhat have those capabilities. So, I do hope you are sensitive to the environment and good luck. Good-bye.

1 of 1

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Document 0018

BMDO Comment Response Line

5/13/94

...Kocsis, and my mailing address is PO Box 20484, Alexandria, VA 22320. My comments cannot be complete because I had sketchy information about the nature of the public hearing, but I've been active in the converting, the defense related articles for these fuels to be.....commercial space research and I would like to continue to do so. In addition, I would not like to ignore the defense needs of the country, but I feel it is gross negligence at this stage, of possibility when we actually have various vehicles that can make equivalent jump into mankinds space extension as Lindberg's flight, and
001 we have various size and various capacity vehicles to serve that both .... and not .... And yet we are only interested in developing newer and newer vehicles like we did not have anything .....Kasikistan and North Dakota. I would like to look into the possibilities how this current chaotic and greatful situation be brought into full action and really put our very best in use. I would like to request a transcript, I would like to know the date of the public hearing and I would like to participate in the debate if it is possible, I will prepare my own agenda if I get a little more information about the topics. Thank you very much and for the best success until then, see you later, I hope at the hearing. Bye-bye.

1 of 1

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Document 0019

BMDO Comment Response Line

5/13/94

John Wright, 3495 Landfair Road, Pasadena CA, 91107. I'd like to support the SSTO rocket technology because of the clean rocket technology and it's because it's a clean
001 rocket technology and it's completely, its very good for the, I mean, it doesn't really hurt the environment as other rocket technologies do. It's what we should, as a nation be perusing. Thanks.

1 of 1

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Document 0020

MARYLAND *Office of Planning*

William Donald Schaefer
Governor

Ronald M. Kreitner
Director

April 27, 1994

Colonel Michael T. Toole
Director, Test and Evaluation
Ballistic Missile Defense Organization
Department of Defense
7100 Defense Pentagon
Washington, DC 20301-7100

STATE CLEARINGHOUSE REVIEW PROCESS

Reply Due Date:	May 26, 1994
State Application Identifier:	MD940325-0232
Project Description:	Draft Programmatic Environmental Impact Statement for Ballistic Missile Defense Program
State Clearinghouse Contact:	Ray Puzio

Dear Colonel Toole:

This letter acknowledges receipt of the referenced project. We have initiated the Maryland Intergovernmental Review and Coordination Process (MIRC) as of the date of this letter. You can expect to receive review comments and recommendations on or before the reply date indicated. Please place the State Application Identifier Number on all documents and correspondence regarding this project.

001 This project has been sent to the following agencies or jurisdictions for comment: The Maryland Military Department and the Maryland Office of Planning.

Your participation in the MIRC process helps to ensure that this project will be consistent with the plans, programs, and objectives of State agencies and local governments. Issues resolved through this process enhance the opportunities for project funding and minimize delays during project implementation.

If you need assistance or have questions concerning this review, please contact the staff person noted above. Thank you for your cooperation.

Sincerely,

Roland E. English, III
Chief, Maryland State Clearinghouse
for Intergovernmental Assistance

REE:RP:dr

301 West Preston Street • Baltimore, Maryland 21201-2365
State Clearinghouse: (410) 225-4490 Fax: 225-4480 TTY: 383-7555

Document 0021

May 9, 1994

Ballistic Missile Defense Organization
ATN: Major Tracey A. Bailey
P.O. Box 4140
Gaithersburg, MD 20885-4140

Dear Major Bailey,

On May 7 I received a copy of Ballistic Missile Defense Draft Programmatic Environmental Impact Statement (April 1994) and I wish to thank you for it. Apparently, when GEOGRAPHOS moved from Los Angeles to Glendale you folks did not receive my sent change-of-address letter. How you managed to track me down is a mystery to me but I am really glad that you went to the effort! The meeting at LA's Hilton Hotel was fascinating--you folks were top-notch but the audience was sure hostile (not me). GEOGRAPHOS is rendered as "Geographics" on page C-10. Probably in 1995 I'll have a paper out
001 in the Journal of the British Interplanetary Society in a special issue devoted to terraforming, which uses global planetary defense systems. I'll forward a copy to you then. If BMDO can just hold on for a couple of more years the international political scene will, by itself, convince more Americans to support and expand its functions! Thanks again.

Sincerely,

Richard Brook Cathcart
GEOGRAPHOS
1608 East Broadway
Suite No. 107
Glendale, California 91205-1524
USA
(818) 246-8422

Document 0023

HYATT
RESORTS

Hyatt Regency Scottsdale
At Gainey Ranch
7500 E. Doubletree Ranch Road
Scottsdale, AZ 85258 USA

Telephone: 602.991.3388

5/29/94

Major Tracy Bailey
BMDO

Dear Maj Bailey:

While traveling I noticed the ad marked "Press Release" in USA Today.

Please tell me, but what in the world is the government doing buying an ad on page 2 of USA Today? And on top of that, one so poorly written and filled
001 with gobbledy-gook ("The Preferred Action is also the No-Action Alternative.") And whatever this is that you want people to respond on, you've of course spared no expense to let them do it: toll free fax, toll free recorded comments, toll free hearing impaired line, translators and signers available at the hearing – why don't you offer the country free rides there, too? Let 'em buy a 29 cent stamp!!

over

Document 0023

This nonsense is typical of all of what is wrong with our country's
001 government and, it seems, its military, too. Perhaps someday, we'll get back government with some common sense.

Sincerely

Michael Austin
1404 Sophia Ave
Utica NY 13502

Document 0033

Matthew J. McGuire
322 Redwood Lane
Cheshire, CT

(203) 272-6643 410-2342
4 May 1994

Major Tracy Bailey
BMDO
P.O. Box 4140
Gaithersburg, MD
20885-4140

Dear Major Bailey:

Regarding the Programmatic Environmental Impact Statement (DPEIS) for the continued research and development

Document 0033

-2-

of a Ballistic Missile Defense (BMD) system;
001 I am concerned that the subject of using potentially ozone depleting chemicals in research and development is not comprehensively addressed and urge that no potentially ozone depleting chemical agents be released into the atmosphere during BMD research.

Sincerely,
Matthew J. McGuire

Document 0034

PUBLIC HEARING TRANSCRIPT
WASHINGTON, DC MAY 12, 1994

MR. BECKER: My name is Eddie Becker, and I'm talking for myself and for no organization.

I really appreciate this kind of a forum. I think it's, it's really a tribute to you and to the process that has begun here; and I think it's very important. You should all be congratulated. And I just think that the study -- the work that has gone into the study, it's quite a lot of work; and I appreciate that.

But I think there's an extra step to make it clearer to the lay person. For instance, if we turn to page 411 in the large book, it says here that -- and I'm just, this is just one example, and I think, I think everyone knows about, about ozone depletion and the problem it poses right now -- and it says here that the, that -- in the center of the page -- "if these combustion products, those containing chlorine particularly hydrogen chloride pose the greatest threat to stratospheric ozone."

Then down in the bottom of the page it says that 15 launches would release an annual total of .726 kilotons of chlorine into the atmosphere. "This is relatively small compared to the 300 kilotons of chlorine released annually from industrial sources."

Document 0034

PUBLIC HEARING TRANSCRIPT
WASHINGTON, DC MAY 12, 1994

Three hundred tons of chlorine released
001 annually from industrial sources. Is that, is that
in the United States or worldwide? Anyway that's
just and aside -- I mean, it would make sense if we
could like understand the risks of what that means
for -- like if someone is born now how many --
what's is -- does their chances of getting cancer
increase? What's the, you know, really the risk
that we have in terms of like that amount of
chlorine being released into the atmosphere and the
depletion of the ozone layer? So that's, that's my
first question; and throughout the study, I think,
you have other examples where, you know, rather
than comparing it like a study that the tobacco
002 industry would do on tobacco products or of
comparing it to what you might get if you were to,
you know, bleed in, you know, put your head in the
chimney kind of, it would be interesting just to
know what it would do, you know, in those terms, in
those terms, in terms that just regular people
could understand, to understand what the impact
is.

The second thing is that in the whole
study you say it's a cumulative study in the whole,
003 I guess, process of developing this system; but, I
think, and from what I understand, there is nothing
here on the manufacturing process.

Document 0034

PUBLIC HEARING TRANSCRIPT
WASHINGTON, DC MAY 12, 1994

Like how many IC's does it take? And
since -- as far as I understand, the worst sites
are in Silicon Valley now. How much dioxin is
being produced, and how much of the process of
004 manufacturing this whole product is going to go up
into the stratosphere? How much pollutants will be
produced? So what's the overall impact from the
whole manufacturing process?

If I'm not mistaken, none of that is discussed in this Environmental Impact Statement. So those are, you know, just two things that I pick out and, of course, if you're -- thank you very much.

COL. JAMES HEUPEL: Well that's -- do, do you have some others. That's one of the things that we are here for is what problems are there that people see from their perspective with the Impact Statement.

MR. BECKER: You know, I think it's very
difficult for a group that's developing something
005 to look at it from a distance. I think it's -- I
think you need to have some independent scientists
come in and examine this really thoroughly.

COL. JAMES HEUPEL: Thank you very much for your comment.

Document 0035

PUBLIC HEARING TRANSCRIPT
WASHINGTON, DC MAY 12, 1994

MR. KENNEDY: Robert Kennedy.

COL. JAMES HEUPEL: Where are you from, Mr. Kennedy?

MR. KENNEDY: Presently, I work in the Subcommittee on Space.

COL. JAMES HEUPEL: Very well. Go ahead, sir.

MR. KENNEDY: Anybody, just for grins,
analyze the impact of what you're actually trying
to protect against? Whose to say nuclear war on
the U. S. -- it's kind of silly -- in my opinion,
001 it's sort of silly to assess the environmental
impact of survival measures when what you're
protecting against is so much worse.

COL. JAMES HEUPEL: Okay.

MR. KENNEDY: That's all.

Document 0036

Mel Carnahan
Governor

Richard A. Hanson
Commissioner

State of Missouri
OFFICE OF ADMINISTRATION
Post Office Box 809
Jefferson City
65102

Stan Perovich
Director
Division of General Services

May 5, 1994

Major Tracy Bailey
BMDO/AQT
7100 Defense Pentagon
Washington, D.C. 20301-7100

Dear Major Bailey:

Subject: 94040082 - Ballistic Missile Defense Draft Programmatic Environmental Impact Statement

The Missouri Federal Assistance Clearinghouse, in cooperation with state and local agencies interested or possibly affected, has completed the review on the above project application.

None of the agencies involved in the review had comments or
001 recommendations to offer at this time. This concludes the
Clearinghouse's review.

A copy of this letter is to be attached to the application as evidence of compliance with the State Clearinghouse requirements.

Sincerely,

Lois Pohl c.m.

Lois Pohl, Coordinator
Missouri Clearinghouse

LP:cm

Document 0037

BMDO Comment Response Line

5/26/94

This is Paul Foer, 921 Boucher Ave. in Annapolis, MD 21403. I just want to express my confusion with this whole thing. Now, I understand that you go through this exhaustive process to determine potential impacts, while these ballistic missiles. My question is, if they're launched, do you file an Environmental Impact Statement beforehand? In other words, before you commit yourself to undertake this enormous destruction that is the purpose and intent of these missiles, do you do an exhaustive study as well - of the thermo nuclear explositions that will result - and what occurs then - from an environmental and sociological and economic impact at that point? Now if you don't, then it brings in the question why are you bothering with this exhaustive study of
001 environmental impacts of the Ballistic Missile Defense Program in the first place? In other words, we're going to spend billions of dollars to keep this system up. And if it's actually used, well, it doesn't matter then, does it? So you'll do all this study of the program itself, but you won't do any study of what happens if you actually execute the true strategic purpose of the program. Does that make sense? I don't really know. So I looked at these Environmental Impact Statements and wondered, well who cares, who cares? If the Air Force Center for Environmental Excellence and the Ballistic Missile Defense Organization was truly concerned with environmental impacts, it would work seriously,

1 of 2

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Document 0037

BMDO Comment Response Line

to lessen the need and to lessen the whole reason for it's own existence. But I suppose that's alot to ask, isn't it? That's my statement, pure and simple. Are you going to file and Environmental Impact Statement before you launch ballistic missiles? Or assuming they are landing in another country, it up to that country that would be
001 receiving the impact to the missiles to file their own Environmental Impact Statement and complain to the Defense Department or to the State Department or to the U.N. in that regard. And the millions and millions of people who may be affected that is, vaporized, in the event of explosions of these missiles. Do each of them get a say before you decide to launch it? Come on, let's get real here. Thank you.

2 of 2

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Document 0039

Dear Maj. Bailey 5/16/94

BMDO's draft PEIS (Adapted Executive Summary) arrived today in perfect order. Thank you.

Please accept my compliments on the PEIS' scope and breadth, and the clarity with which it was written.

001 I am appalled that no more than 310 members of the public responded during the scoping process. Frankly, I regard BMDO's efforts to elicit public participa-tion deficient. Thomas B. Killeen

Document 0041

SDSU

INSTITUTE FOR INTERNATIONAL SECURITY
AND CONFLICT RESOLUTION (IISCOR)
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SAN DIEGO CA 92182-0325
U.S.A

TEL: (619) 594-4352/6240
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TWX: 910-335-1733

Major Tracy Bailey
BMDO
P.O. Box 4140
Gaitherburg, MD 20885-4140

May 27, 1994

Re: DPEIS

Dear Major Bailey:

This letter is in response to the Draft Programmatic Environmental Impact Statement (DPEIS) issued April 4, 1994. In reading the DPEIS, I have discovered that it is deficient in addressing an important issue, namely the potential environmental and health risks associated with a successful targeting of incoming warheads by the NMD system. This might be considered the 'environmental impact of the impact'.

There are two important considerations regarding the negative consequences of a successful NMD system: (1) the environmental/health risks caused by the dispersal of fissile material from the incoming nuclear warheads, and (2) the strategic advantage gained by a potential adversary in counting on a successful targeting of his warheads. Neither of these two considerations was explored by your DPEIS.

001

Dispersal of fissile material

In the event of an accidental or unauthorized launch of nuclear weapons against US territory, its military assets or its allies, or in the event of an act of aggression involving such targeting, potentially *serious consequences would result from a successful interception* of the incoming warheads. For the following discussion, I am borrowing heavily on the calculations found in the S. Ferrer and F. Von Hippel article entitled, 'The Hazard from Plutonium Dispersal by Nuclear-warhead Accidents' (Science and Global Security vol. 2, pp. 21-41, 1990). Ferrer and Von Hippel assume that each warhead contains approximately 3 kg of plutonium and that a non-nuclear explosion would convert about 20% of that plutonium into a

THE CALIFORNIA STATE UNIVERSITY

Document 0041

PuO_2 aerosol of the size that could be inhaled by the human lung. The remaining ^{239}Pu and other hazardous materials could be deposited on land or in water and ultimately get into the food chain. The total lung plus bone cancer risk of the inhaled PuO_2 is estimated to be 3-12 (ave 7.5) cancer deaths per mg of PuO_2 inhaled or 7.5×10^6 cancer deaths per kg which calculates to 4.5×10^6 potential lethal doses of PuO_2 per warhead (assuming that only 20% of the ^{239}Pu is converted to PuO_2). Thus, the contents of one warhead dispersed over a population center like San Diego (1.1 million) would result in the dispersal of ~4 lethal doses of PuO_2 per person. These numbers only represents *potential* lethal doses; the number of actual doses would depend upon many factors, including the height of the explosion, the type of explosion, whether or not the Pu is dispersed over a population center, atmospheric conditions, etc. For example, the risk factors would be dramatically reduced if the Pu was dispersed as chunks instead of as inhaleable particles and the risk factors would be increased if more of the Pu was converted to PuO_2, if the warheads were salvage-fused or did not contain insensitive high explosives (IHE). I will not attempt these calculations here.

Defeating the system - a new twist

001 A traditional strategic argument against any BMD system is that a potential adversary would try to develop methods of circumventing the system. This has been the source of debate ever since ballistic missile defenses were envisioned and was a particularly heated debate over the 1972 ABM Treaty. A potential new and ironic twist to this old argument is that **the enemy would not attempt to defeat the system, but rather take advantage of it.** I am reminded of the occasionally successful interception of Scud missiles by the Patriot system during the 1991 Gulf war. You will recall, that our side worried that Saddham had chemical or biological warheads on the Scuds that were targeted against our troops in Saudi and against our friends in Tel Aviv. As the Scuds were hit by the Patriot missiles, I wondered, what the adverse consequences would be if those warheads had contained chemical or biological weapons (CBW). One could argue that a **successful interception of a missile carrying a CBW warhead could, in fact, aid in the dispersal of the agent**. Thus, the NMD system proposed by the BMDO could be anticipated and taken advantage of by an adversary. A potential nuclear proliferant with knowledge that we had an effective ABM system might change his strategic planning, particularly if the ABM system was a terminal defense like the NMD system is envisioned to be by the BMDO where the warheads would be intercepted over our territory. Rather than using an explosive nuclear warhead on his ballistic missile, the enemy

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could use radiation warheads to disperse lethal radionuclides or use CBW warheads which would release toxic agents over population centers. According to S. Fetter (International Security v. 16, 5-42, 1991), one
001 warhead containing anthrax spores delivered by a ballistic missile targeted to a major population center would produce 20,000-80,000 casualties. Warheads could even be salvage-fused or otherwise triggered by a successful interception by our ABM system.

Conclusions

A successful interception of a only a few warheads would release to the environment toxic substances or long-lived radionuclides that would represent a catastrophic health risk to humans and potential adverse effects on the ecosystem and agriculture. Certainly if the ABM system works, the adverse consequences of its success could be significant. As a scientist who normally appreciates technological advance, I must say that, in the context of the above discourse, I am convinced that a technological solution to accidental or purposeful launch of warheads against the US is not feasible nor advisable. Rather, I believe that a more
002 promising solution would come from arms control, diplomacy and cooperation, instead of the questionable technological fix that ballistic missile defenses would provide. The START process has demonstrated that more warheads can be eliminated by arms control agreements and unilateral initiatives than would be neutralized by a ballstic missile defense system. The recent rapprochement between the Israelis and Arabs has demonstrated that a political accord can have a longer range than a ballistic missile.

Sincerely,

Roger A. Sabbadini, Ph.D.
Professor of Biology and Molecular Biology Institute
Executive Board
Institute for International Security and Conflict Resolution
(619) 594-6272
Fax (619) 594-5676

Document 0043

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF ENFORCEMENT

Major Tracy Bailey
BMDO/AQT
7100 Defense Pentagon
Washington, DC 20301-7100

Dear Major Bailey:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, we have reviewed the "Ballistic Missile Defense (BMD) Draft Programmatic Environmental Impact Statement (EIS)." We commend the Department of Defense's efforts in examining the environmental issues associated with the broad research, development, and testing activities of the BMD program and appreciate this opportunity to comment.

Because the draft EIS primarily discusses the action on a programmatic level rather than on the operational level, we have limited our review to the broader issues involving the action. We have attached some general comments for your consideration in the final EIS. Based on our review of the draft programmatic EIS, EPA has rated this document LO (Lack of Objections). A summary of EPA's rating definitions is attached for your information.

We appreciate the opportunity to comment on the draft programmatic EIS and welcome the opportunity to review the final EIS and subsequent individual EIS's. If you have questions, please give me a call at (202) 260-5053 or have your staff contact Marguerite Duffy at (202) 260-8799.

Sincerely,

Richard E. Sanderson
Director
Office of Federal Activities

Enclosures

Document 0043

Comments on the Ballistic Missile Defense Draft Programmatic Environmental Impact Statement

Wetlands

It is difficult to comment on individual or cumulative impacts to wetlands prior to selection of specific sites for BMD activities. However, we wish to point out that the requirements set forth in Section 404 of the Clean Water Act must be followed should BMD activities involve the discharge of dredged or fill material into waters of the United States, including wetlands.

001 The document states that it is unlikely that the action will require any new construction involving wetlands, but, if wetlands are to be filled, it would be permitted under one or more Corps Nationwide Permits. Note that should the Corps Nationwide permits not apply to any proposed discharge, an individual Section 404 permit (issued by the Corps) would be necessary. An individual permit is granted only after the applicant has demonstrated that there is no practicable alternative which is less damaging to the aquatic environment and that the discharge would not result in significant degradation of the Nation's waters.

Electromagnetic Radiation

The draft programmatic EIS addresses electromagnetic radiation. This includes radiofrequency (RF) radiation from radar that would be used to track targets, extremely low frequency (ELF) electromagnetic fields from the electric power transmission lines that would supply electric power, and x-radiation used for component testing. The following comments relate to nonionizing electromagnetic fields.

The conclusion of the draft is that "most NMD (National Missile Defense) electromagnetic radiation (EMR) generated by electric power lines, sensors, or communication systems would not
002 adversely affect human health or wildlife, or interfere with the communications." This conclusion is based on statements in the document that maximum permissible exposure (MPE) limits recommended by the 1991 Institute of Electrical and Electronics Engineers (IEEE) radiofrequency radiation standard would not be exceeded.

ELF electromagnetic fields and RF radiation are not individually treated in the general discussion about exposure. A specific example of this difficulty is that exposure intensity is described in terms of power density (W/m2) for both frequency ranges. This confusion leads to the impression that the topic of electromagnetic fields is not being dealt with carefully. We believe this topic warrants separate discussion.

Document 0043

POLICY AND PROCEDURES 1640
10/3/84

SUMMARY OF RATING DEFINITIONS
AND FOLLOW-UP ACTION*

Environmental Impact of the Action

LO—Lack of Objections
The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC—Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO—Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alterna tive or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU—Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1—Adequate
EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2—Insufficient Information
The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3—Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment.

Figure 4-1

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BMDO Comment Response Line

5/31/94

Yes, my name is Lawrence Stice. Address is 14651 Taft Street, Garden Grove, CA
92643. I want to express my positive attitude toward the continued missile research
and anything else that will help the United States maintain a military superiority over
the rest of this aggressive nations, is to our advantage. We may never have to use it,
but as long as we've got it we have a deterrent to future problems with communist
001 aggression or any other country that decide that we aren't as big a bully as they think
we are. Anyway, I'm for continued efforts, not only on the ground, but in space based
interceptors, and I think the Star Wars program should be continued even now as we
speak. Thank you very kindly, and I would a copy of anything that comes out of this,
and I'd be happy to give more positive more information if I can, in any way. Thanks.
Bye.

1 of 1

This is a true copy of a voice recording. 6/1/94 RALPH P. BARR, JR, Notary Public, Howard Co., MD. MY COMMISSION EXPIRES 9/1/95.

Document 0045

BMDO Comment Response Line

5/31/94

Hello, my name is Holly Jenkins, Post Office Box 14746, Alaska, 99835. I'm sending
you a letter, but it's kind of like I'm sending it today, I just wanted to make sure you
got the comments, at least, if the letter didn't get there. This dear Major Bailey is a
victim of what I consider remotely the or raider, it's obviously since 1992. I would hope
001 that in any testing or research on our defense system would not include tests which
would possibly hit nor endanger animals. That's to say, it was obvious that I was been
hit by something after that time. Before that I believe I was, I wasn't sure.

Next paragraph

I have experienced these painful possibly destructive vixens, sadists and I do consider them that, in Anchorage, Alaska in the early 80's to my lower back and in American Somoa, Pago Pago Harbor, and...and my eyes when my sunglasses fell off I think I'm being, been hit by something which gives me burning in eyes it comes and it goes. I've experienced the same here in Seattle, Washington on the way southside of Bishop Drive, on the Alcan Highway in 1992. I experienced when I was driving in my car, a really strong pull in my eye and a change in my ocular vision, which was temporary, except this has happened to me again, that my vision goes back to what is was. I was forced to stop in a rest stop and protect my face with my portable computer, that's all

1 of 2

This is a true copy of a voice recording. 6/1/94 RALPH P. BARR, JR, Notary Public, Howard Co., MD. MY COMMISSION EXPIRES 9/1/95.

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BMDO Comment Response Line

I had. I was scrunched down in the right side and put in front of my face, my body....(message interrupted)

Hello, my name's Holly Jenkins, P.O. Box 14746, I was just cut-off when I was talking, perhaps it carried on too long. Anyway, I did send a letter, I would like you to send a Draft and A Summary if this isn't something that you just mainly send to major corporations. 'Cause I really am interested in what this is all about, because there, it seems from reading, especially about thing Air Force Base in Ohio, that things should be undone using thoughts to initiate activities or voice or something, I'm concerned that other people besides the United States Department of Defense are getting it and causing damage to individuals and groups such as Indians and handicapped people and elderly people and people at VA hospitals. That's my difficulty with, with anything, whether it's research or whether it's the actually thing. That's why I find it a problem. I was just going on and on about my particular problem. I am an individual and I don't know exactly why this is happening to me, but it isn't fun, and I think there are people including my parents that experienced this, they're both dead now. So if you could send me information about this, I would appreciate it and I'd appreciate you're being careful, when you develop it. Thank you very much. Good-bye.

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This is a true copy of a voice recording. 6/1/94 RALPH P. BARR, JR, Notary Public, Howard Co., MD. MY COMMISSION EXPIRES 9/1/95.

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22 May 1994

Major Tracy Bailey
BMDO/AQT
7100 Defense Pentagon
Washington, DC 20301-7100

Dear Major Bailey:

Here are my comments on the April 1994 Ballistic Missile Defense Draft Programmatic Environmental Impact Statement (PEIS). Also included are three Appendices containing a newspaper article and my comments on two related Environmental Impact Statements. Appendix 2 contains my comments on the October 1993 Final Restrictive Easement EIS for Strategic Target System (STARS) and Vandal launches. Appendix 3 contains the comments I submitted on the December 1993 Final Supplemental EIS (FSEIS) for Proposed Actions at U.S. Army Kwajalein Atoll (USAKA). I have received no response to either set of comments. Various comments in these Appendices are referenced in the comments below.

001 1) On pages ES-2 and 1-15, the issue of potential contravention of the ABM Treaty is said to be outside of the scope of this PEIS. Yet ABM Treaty restrictions and the treaty compliance process are mentioned at several places in the PEIS, notably in section 1.3.6. ABM Treaty compliance should be an important element of the PEIS because it restricts what ABM tests can be done, limits ABM deployment to a single site at Grand Forks, North Dakota, and forbids TMD tests "in an ABM mode."

002 2) Section 1.1.2.3 discusses possible elements of an NMD system at a single site and mentions that other sites, including sites in Alaska and Hawaii, might be added. This section ends with the vague statement that, "Provision of any NMD system other than agreed upon in the ABM Treaty would require modification of the treaty." It should be added that only a single site at Grand Forks, N.D. is allowed by the ABM Treaty. More details should also be given about other sites that are being considered for ground-based NMD elements. The newspaper article in Appendix 1 indicates that seven sites were being considered in March of 1992.

003 3) On page 1-12, it is stated that, "The BMDO Program will continue to be conducted in a manner that complies with all U.S. obligations under the ABM Treaty." There should be a more detailed discussion here of the ABM Treaty restrictions on tests involving space-based sensors (SBS) and space-based interceptors (SBI). This is especially important because the narrow interpretation of the ABM Treaty would forbid SBI and possibly SBS tests whereas the broad interpretation adopted by the Reagan Administration would have allowed such

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003 tests.

004 4) Section 1.3.7 discusses public involvement and states that BMDO "will promote the public comment process in an efficient, effective manner." This would be a welcome change from past practice on environmental analyses of BMD launches from the Kauai Test Facility (KTF). For example, the Administrative Record (AR) for the Strategic Target System (STARS) EIS was not made available for public review until September of 1992, four months after the final EIS was issued. Several important documents missing from this AR were not available until December of 1992. The most egregious disregard for public involvement is illustrated by the Environmental Assessment (EA) for the CDX project at KTF. The Finding of No Significant Impact for this project was signed on 22 May 1992 and the CDX launch occured early in the morning of 24 May, but the CDX EA was not sent to the Hawaii Office of Environmental Quality Control (which regularly publishes notices of EA's received) until November of 1992.

005 5) The last three lines on page 1-15 are repeated at the top of page 1-18.

006 6) The discussion of contingency deployment planning on page 2-12 indicates that the Technology Readiness Program "could quickly become an acquisition program during any epoch." It is ironic that this statement is reminiscent of the charge made in the 1980's that the Soviet Union was conducting its ABM research in such a manner as to allow a rapid breakout from the ABM treaty. Indeed, from the emphasis given to "critical technologies and capabilities to minimize the time required to deploy an initial system" by the Technology Readiness Program, it seems that the intent of this program is to provide the impetus for deployment of an NMD system (similar to the GPALS system envisioned during the scoping process for this PEIS) which would violate the ABM Treaty.

007 7) The acquisition alternatives including SBS and SBI would violate the ABM Treaty prohibition of space-based ABM systems. These ABM Treaty restrictions should be explicitly stated in the discussion of the acquisition alternatives.

008 8) The discussion of alternatives should include an alternative which involves basic research on technologies relevant for missile defense without epochs structured toward acquisition and deployment decisions.

009 9) Because all of the alternatives considered involve launches simulating long-range attacking missiles, the PEIS should state what types and quantities of boosters are available and what restrictions are placed on their use by the START I and START II treaties. In particular, the PEIS should discuss restrictions on launches which encrypt telemetry data and explain why these data need to be encrypted.

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010 10) On page 3-13, it is stated that the Clean Air Act Amendments of 1990 established phaseout of production and use of Class I ozone-depleting substances, which include CFC's and halons, by January of 1996. The STARS booster which is scheduled to launch a variety of BMD experiments from KTF in the next nine years emits 90 kilograms of halon 2402 (also known as freon 114B2) directly into the stratosphere. Unless a substitute for halon 2402 is used, it appears that STARS launches after 1995 will violate the Clean Air Act Amendments.

011 11) On page 4-3, it is stated that the emission rates for the major exhaust products of the STARS booster are "below applicable standards." This statement is presumably based upon computer model predictions of the concentrations of carbon monoxide and hydrogen chloride at the boundary of the ground hazard area (GHA). However, documents in the AR for the STARS EIS indicate that the hydrogen chloride concentration is predicted by the REEDM computer model to exceed the Hawaii guideline both for a normal launch and for an early flight termination. The monitoring data at the boundary of the GHA for the first STARS launch cannot be used to check the computer calculations because the site monitored was not downwind of the launch pad. The hydrogen chloride data from monitors at the Auxiliary Equipment Building (AEB) 44 meters from the launch pad are inconsistent. One monitor recorded a plateau value of 43.5 ppm for a period of 100 seconds; two other monitors recorded peak values of 77 and 80 ppm respectively. (See comments 5 and 12 in Appendix 2.)

012 12) On page 4-4, it is asserted that much of the carbon monoxide emitted by the STARS booster oxidizes to carbon dioxide. No data are cited to support this assertion. The data from the carbon monoxide monitors at the AEB site for the first STARS launch appear to be unreliable. (See comment 11 in Appendix 2.) A 14 March 1994 letter from the U.S. Army Environmental Hygiene Agency (USAEHA) to the Hawaii Dept. of Health states, "At this time, the USAEHA does not have a definitive reason for the delayed spike in the CO time series trace."

013 13) Several rocket motors used for BMD tests exhaust substantial quantities of lead. According to the 1992 KTF Environmental Assessment, the Talos motor emits 47.65 pounds and the Terrier motor exhausts 20.25 pounds. Previous EA's for launches at KTF stated that these lead releases were reportable under the Comprehensive Environmental Response and Liability Act (CERCLA). However, the Final Supplemental EIS (FSEIS) for USAKA asserts that these releases are not reportable. This contradiction should be resolved in this PEIS. I have included my comments (dated 25 March 1994) on the FSEIS for USAKA in Appendix 3. (See comment 10.) The impacts of these lead releases and the cumulative impacts of lead releases from launches for other programs should be evaluated in this PEIS.

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014 14) This PEIS should give a summary of the reliabilities for boosters that have been used and are planned to be used for BMD tests. This is important to allow the public to make a realistic evaluation of the likelihood of a catastrophic failure. The reliability of 97% given for the STARS booster in the STARS EIS is misleading because the Sandia memo upon which this number is based assumed 100% reliability for the 1st and 2nd stage rocket motors. The 16 Dec. 1992 Technical Review of STARS Reliability by David Wright, Senior Staff Scientist of the Union of Concerned Scientists, should be analyzed along with data from launches since this review. (See comment 1 in Appendix 2.)

015 15) Past launch failures should be described so that an evaluation can be made of the potential impacts of similar failures in future launches. Two failures are especially important. The 20 August 1991 Aries failure (first launch in the Red Tigress program) is important because debris hit the ground outside the launch danger area. I urged that this failure be examined in my comments on the draft STARS EIS. The response in the final STARS EIS stated that the launch danger area for this Aries launch was 2,600 feet and that the flight termination 23 seconds into the flight "still allowed all debris to fall within the debris impact area." I subsequently wrote several letters to SDIO pointing out that this statement seemed to contradict newspaper reports and asking for detailed information. The responses did not provide information about where debris actually hit. On 20 Oct. 1992, the Sierra Club Legal Defense Fund (SCLDF) made a Freedom of Information Act (FOIA) request for information about this Aries failure; the 25 Nov. 1992 reply from the Army Strategic Defense Command asserted, "we have no documents concerning the August 20, 1991 Aries launch failure." The 11 August 1993 letter to me from Thomas Johnson of BMDO finally stated that information about the Aries failure could be obtained from the Commander of Patrick AFB. In response to a 23 March 1993 FOIA request, SCLDF received a letter (dated 24 March 1994) from Patrick AFB which stated that the Red Tigress Incident Report (dated 23 August 1991) had been determined to be releasable. A copy of part of this report (all of the Appendices and some of the main text is missing) accompanied this letter. This report states, "The data shows that the debris traveled as far as approximately 13,500 feet from Complex 20, with impact occurring a maximum of 100 feet inland."

The other failure that should be examined is the15 June 1993 Minuteman I failure at Vandenberg AFB. The debris from the exploded missile seems to have fallen within about one nautical mile of the launch pad. However, according to *newspaper reports*, brush fires started by the burning debris burned 400 acres on the base and 600 acres off base. (See comment 3 in Appendix 2 and comment 5 in Appendix 3.)

016 16) On page 4-37, it is asserted that space-based elements "would pose little or no safety hazards." The only hazard envisioned is orbital debris from an SBI that

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016 explodes accidentally. However, a 17 May 1994 New York Times article reported that debris from launches to deploy satellites is already a sufficiently serious hazard that the National Academy of Sciences is doing a study of the debris threat. NASA is also considering measures to reduce debris from future launches. The article also reports that a U.S. anti-satellite weapon test in 1985 produced 285 trackable pieces of debris. Therefore, the PEIS should examine how much additional orbital debris BMD activities will contribute. Deployment of space-based weapons could result in a more serious accident in which an SBI attacks a satellite or a Space Shuttle. Presumably there would be safeguards to try to prevent such accidents, but the recent incident in which U.S. fighter planes shot down two U.S. helicopters over northern Iraq is a reminder that safeguards can fail with disastrous consequences.

017 17) On page 4-40, it is noted that hydrogen chloride and aluminum oxide in the exhaust clouds of Space Shuttle and Titan IV launches caused acidification of surface water near the launch pads. Increased hydrogen chloride concentrations were also observed in 87% of soil samples taken after the 1st STARS launch. (See comment 16 of Appendix 2.)

018 18) On page 4-56, it is stated that the developed areas that are likely to be used for BMD activities are unlikely to contain intact archaeological resources. This is not the case for the Kauai Test Facility. According to the STARS EIS, the entire Pacific Missile Range Facility (which includes KTF) "is located within an archaeologically and ethnographically sensitive area of Kauai." In addition, the STARS launch facility is within a major ancient burial ground.

019 19) The discussion of land use issues for the acquisition alternatives notes (see for example page 4-68) that, "Basing NMD components could involve new construction in several local communities." This emphasizes why the potential locations of these sites (see newspaper article in Appendix 1) should be evaluated in more detail.

020 20) For nearly every aspect of potential environmental impact, it is claimed that the cumulative impacts of BMD activities and other sources "are not possible to assess until specific sites are selected." However, there are at least three sites (USAKA, KTF, and Vandenberg Air Force Base) where BMD activities have been going on for some time and where substantial activity is planned. At the very least, cumulative impacts should be assessed for these sites.

021 21) The cumulative impacts of lead emissions on soil and water quality are particularly important to consider at KTF because elevated lead levels were already detected in some soil samples taken for the 1992 KTF EA and the Navy plans as many as 72 Vandal launches (which would release over 3,400 pounds of lead) over

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021 the next nine years. (See comment 7 in App. 2 and comment 9 in App. 3.)

022 22) Section 4.16 covers irreversible and irretrievable commitments of resources in just two pages. Much more detail is needed to allow an evaluation of these impacts. For example, to evaluate the impacts of the loss of human resources for other projects, one needs information about the number of people involved in BMD activities. Evaluation of the impacts of the loss or limited availability of land used for BMD activities requires information about how much land is being used and other potential uses for this land. This is especially important at Kwajalein Atoll, where USAKA occupies a large fraction of the land and the Marshallese are confined to the overcrowded island of Ebeye. Evaluating to what extent some or all land at BMD sites could be returned to former uses requires information about contaminated areas at these sites and cleanup efforts that would be required.

023 23) An area not addressed in the draft PEIS concerns the impacts of secret Defense Dept. programs involving rocket launches at BMD sites. How can the U.S. Congress or the public evaluate the impacts of these secret programs? An example of a program that could have catastrophic impacts is the Timberwind program to develop rockets powered by nuclear reactors. A 3 April 1991 New York Times article reported that such rockets were being considered for launching BMD weapons into orbit.

024 24) Another area that should be discussed in the final PEIS is cooperation with local governments. There have been instances in the past where local governments have been ignored or misled about BMD activities. I already mentioned the disregard for public and local government involvement in review of the STARS EIS and the CDX EA in comment 4. The monitoring program for the 1st STARS launch is an example of local governments being misled. The monitoring protocol in the AR for the STARS EIS specified six sites at which air quality would be monitored, but only two sites were actually monitored. Apparently, the change from six sites to two sites was never discussed with the Hawaii Dept. of Health. (See comment 9 in Appendix 2.) Another example is the proposed USAKA Environmental Standards and Procedures. A joint USAKA-Marshallese task force worked for three years and apparently reached a consensus that environmental analyses of major new projects at USAKA would have required the approval of the Marshallese government. However, the proposed Environmental Standards and Procedures that accompanied the Supplemental USAKA EIS only require that the Marshallese be consulted. (See comment 13 of Appendix 3.)

025 25) Finally, several past instances demonstrate why official statements about BMD activities lack credibility. On 18 August 1993, the New York Times reported charges by four former Reagan Administration officials that some BMD tests were rigged and that Congress was misled about test results. The 13 Sept. 1993 General

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025 Accounting Office (GAO) report on STARS indicates that there were alternatives to STARS launches at KTF. This finding conflicts with statements made in the Record of Decision for the STARS EIS signed on 22 June 1992 by SDIO Director Cooper. In his 17 Sept. 1993 letter to Defense Sec. Aspin accompanying this GAO report, Congressman Conyers concluded, "Star Wars officials apparently misled the public and the Congress on the existence of acceptable alternatives to launching these test missiles from Hawaii."

Another example involves statements made about the British experiment Zodiac Beauchamp (ZB), which was included on the 2nd STARS launch. The 22 Dec. 1992 affidavit of James D. Carlson, Acting General Manager of SDIO, stated that this launch "must be conducted by early summer 1993, since flight certification of the British payload expires in June 1993." On 2 May 1993 I wrote to SDIO to ask for information about the ZB experiment -- including what it contained for which certification was critical. I also asked whether ZB would be included in the 2nd STARS launch, which had been been delayed to August, even though the ZB certification would have expired. The 10 June 1993 response stated that ZB "is not a warhead" but did not give any details about what it was or what required certification. The only response about certification was, "The statement of Dr. Carlson was true at the time of his affidavit, but because of the benefits to be accrued by this experiment, the British re-evaluated the payload and extended the flight certification."

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APPENDIX 1

The Sunday Star-Bulletin & Advertiser Honolulu, March 8, 1992 A11

Hawaii 'Star Wars' star?

Site is scheduled to be installed here, if plan flys

By Alicia Brooks
States News Service

WASHINGTON — Once upon a time, in a future far, far away, Hawaii may be one of seven states to host a Strategic Defense Initiative station if Pentagon advocates of the system get their way.

But while Pentagon officials firmly believe that their program — dubbed "Star Wars" — should be completed, a knowledgeable congressional source said it's "somewhere between unlikely and extremely unlikely" that the $90 billion project will ever fly.

The long-controversial project, championed by former President Ronald Reagan, is designed to provide a "nuclear shield" by placing missile detectors and interceptors on land in the United States and Europe, and in space.

For Hawaii, the plan would mean a land- or ship-based Star Wars installation, including a giant radar system, and possibly 100 rocket interceptors that could destroy incoming missiles, according to the SDI Organization spokeswoman, Maj. Carolyn Channave.

The plan calls for Hawaii's station, one of seven around the country, to begin operations between 1998 and 2002. Hawaii's site, like one in Alaska, would be required because no other location could offer protection to the remote state, Channave said.

Other land bases marked with an "X" on a rough, schematic map of the program, include Northern California, the Arizona-New Mexico border, Florida and somewhere in New York state.

But the first phase of the project — a single station in Grand Forks, N.D., or a site near it — is already behind schedule, and likely will not be operating until 1997, a year behind schedule, Maj. Gen. Malcolm R. O'Neill, military head of the SDIO, told the Associated Press.

O'Neill said delays had been caused by a lack of money from Congress, which appropriated $4.1 billion for the project in 1992. Congress is likely to cut the administration's $5.4 billion request in 1993, the congressional source said.

While development of the North Dakota site has been authorized by Congress, further congressional approval will be required for actual deployment. And while the North Dakota site is allowable under the 1972 U.S.-Soviet Anti-Ballistic Missile Treaty, no further sites are. Hawaii's site would require breaking the current treaty, or negotiating a new one, Channave said.

But the congressional source said it's unlikely the Hawaii site will ever be developed, adding:

"There is some consensus (in Congress) for doing a single site in Grand Forks, N.D., but little consensus for going beyond that."

"Beyond that" includes Hawaii and the six other sites, plus "Brilliant Eyes," space-based sensors designed to detect incoming missiles. Beyond that phase lies "Brilliant Pebbles," space-based anti-missile missiles.

"There is little consensus for putting anything beside sensor satellites up in space, and absolutely no consensus for putting weapons in space," said the source.

Members of the Union of Concerned Scientists, one of Star Wars' most vocal critics, say safety implications of a ground-based station are uncertain.

Union research director Michael Brower said the unintentional launch of an interceptor, and the electromagnetic field created by the radar, are hazards the military will have to deal with.

But Channave said Hawaii is a crucial part of a successful shield system.

"Hawaii is a critical juncture because of its location," Channave said. "It is the crossroads in the Pacific; one place that people are very interested in if they wanted to block communications from one side to another of the world.

"You cut Hawaii out, and suddenly the East and West can't talk."

APPENDIX 2

26 October 1993

Dept. of Land and Natural Resources
Attention: W. Mason Young
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Young:

Here are my comments on the Final Restrictive Easement Environmental Impact Statement dated October 1993. Some of the errors and omissions in the draft EIS have been corrected, but the final EIS is still inadequate in several important areas. I urge you to consider these comments and to have the air quality issues reviewed by the Dept. of Health before making a decision about the Restrictive Easement.

1) STARS reliability: The response to my 28 August comments finally acknowledges that the 97% overall reliability given in the STARS EIS assumed 100% reliability for the Polaris 1st and 2nd stage rocket motors. Because the Army still refuses to reveal the actual Polaris reliabilities, David Wright's Dec. 1992 report on Polaris and Minuteman I reliabilities should be used as the basis for estimating the probability of a STARS failure. The Polaris reliability of 92.8% implies that the probability of at least one failure in 13 launches is 62%. A reliability of 82% (based on the record for refurbished Minuteman missiles) would imply a 92% probability for at least one failure in 13 launches.

2) Vandal reliability: The response to my 28 August comments states that, in 37 Vandal launches since February of 1991, there have been "no failures occuring during the boost phase that would affect the GHA." This statement seems to be contradicted by document 411 of the STARS EIS Administrative Record, which contains the comment "TGT BROKEUP AT LAUNCH" for the Vandal launch at PMRF on 7 March 1991. I referred to this Vandal failure in my August comments so it is especially hard to understand why it was ignored.

3) adequacy of the STARS ground hazard area (GHA): The response to my 21 Sept. comments concerning the Minuteman I failure at Vandenberg Air Force Base dismisses consideration of this failure as a possible STARS failure as "inappropriate." The response does not include any detailed evaluation of the potential for brush fires to cut off access to Polihale State Park or of the PMRF fire-fighting capabilities. Neither of these issues was examined in detail in the STARS EIS.

4) Vandal GHA: The response to my 28 August comments asserts that there are "ample data for assessing the adequacy of the Vandal GHA." It is precisely these data that my previous comments asked to be provided in the final EIS. No data are included in the

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final EIS nor are there any references to documents that contain such data. This inadequacy is especially glaring because apparently there has never been any environmental assessment for Vandal launches at PMRF.

5) HCl concentrations from STARS: The response to my 28 August comments corrects the statement in the draft EIS that, "The Hawaii HCl guideline is not expected to be exceeded by a Strategic Target System launch or launch failure." It finally admits that the REEDM modeling done for the STARS EIS indicates that the Hawaii HCl guideline will be exceeded beyond the GHA both for a normal launch and for a launch failure. The Hawaii Dept. of Health should state its views on having the HCl guideline exceeded and whether it accepts the contention in the EIS that the Short-term Public Emergency Guidance Level (SPEGL) is the more appropriate standard for comparison.

6) reporting lead releases from Vandal and STARS launches: The response to my 28 August comments completely avoids discussion of the statement in the draft EIS about lead releases "... nor was it intended that such routine emissions would be characterized as 'releases' for purposes of reporting requirements under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)." No explanation is provided why this statement was made in contradiction to statements about lead releases from rocket launches in previous environmental documents, including the STARS DEIS. The response indicates that, as of 30 June 1993, the reportable quantity for lead is 10 pounds; it does not address what, if any, reporting was done of lead emissions from Vandal and STARS launches before 30 June 1993, when the reportable quantity was one pound. Finally, the response states that "the U.S. Navy is in the process of evaluating the requirement to report lead releases." This evaluation should have been done before the final EIS was issued so that State of Hawaii officials and the public could evaluate what actions the U.S. Navy plans to take.

7) impacts of lead release: The response to my 28 August comments does not address whether it is justified to conclude that there will be no significant impact from 72 Vandal launches based solely on assertions in the ZEST Environmental Assessment that no significant impacts were expected from two launches. (One wonders whether the EIS authors would accept the argument that, if canceling two STARS and Vandal launches is not significant, then canceling 72 launches would not be significant.) The response does state that the Navy will do a baseline survey and periodic monitoring around the Vandal launch site. This baseline survey should have been done before the final EIS was issued. The results of this survey and the detailed plans for the monitoring should be made available for public examination before the State of Hawaii makes a decision about the Restrictive Easement. In addition, the Hawaii Dept. of Health should state whether the elevated levels of lead observed in soil samples taken near some KTF launch sites are acceptable.

8) Vandal launch products: Response 11 to my 28 August comments implies that the

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quantities given in the July 1992 KTF EA for the Talos rocket motor used for Vandal were for total propellant weight, not weights of combustion products. These weights are contained in Appendix F of the KTF EA, which is titled "Rocket Motors and Composition of Exhaust Products". Therefore, the inconsistency between the weights in the EIS and in the KTF EA is still not resolved.

9) air quality monitoring for the 1st STARS launch: Response 12 to my 28 August comments contains two assertions for which no documentation is provided. First, it is claimed that the Hawaii Dept. of Health Clean Air Branch was consulted about the July 1992 revisions in the monitoring protocol which reduced the number of monitoring sites from six (in the Nov. 1991 protocol) to two. No documents indicating the Dept. of Health's consent to these changes are provided. Furthermore, a 27 July 1992 letter to me from Bruce Anderson, Deputy Director for Environmental Health, included a diagram indicating six monitoring sites for the first STARS launch. Second, no documents are provided concerning consultation with the Clean Air Branch in June 1993 The only "consultation" that seems to have occurred was a phone call to find out the status of the monitoring report. My experience trying to get a copy of this report indicates reluctance even to release it. I made several phone calls to Peter McClaran at PMRF and to Tyler Sugihara in the Clean Air Branch to try to get a copy of the report. In early August, I called Linda Ninh at the Army SSDC to ask that she send me a copy. She said that there were no plans to distribute this report widely and in particular no plans to send it to the Hawaii Dept. of Health. I suggested to her that a copy should be sent to Tyler Sugihara.

The last paragraph of response 12 asserts the accuracy of the statement that "no appreciable pollutant-specific concentrations were measured at the GHA-S monitoring location during the STARS FTU-1 launch." This statement and the related statement (see page 4-1 of the EIS) that monitoring results "confirmed that no significant impacts to the human or natural environment occurred" are incomplete and misleading. Because the GHA-S monitors were not directly downwind, they could not have detected (even if they had all functioned properly) high concentrations of HCl and other pollutants in the exhaust plume. Data from these monitors cannot be used to validate the REEDM predictions and do not imply that HCl concentrations at downwind sites would be insignificant.

10) DIFOUT computer model: Response 13 to my 28 August comments concludes that "there is no purpose served by performing the comparison between the DIFOUT, TRPUF, and REEDM models." This conclusion is to be expected if one does not care about the reliability of these models or what they predict. Unfortunately, this seems to be the attitude of the authors of the current EIS and of the STARS EIS. The result is that there are no nitrogen dioxide predictions to compare with the measurements and no predictions at a distance from the launch pad comparable to that where the AEB measurements were made.

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11) AEB carbon monoxide monitoring results: Response 14 to my 28 August comments refuses to "speculate" on why the CO concentration shows a peak above the background level for only one 10-second interval 2 minutes and 30 seconds after the launch. It is not speculation, but explanation, that is required when the data do not make sense. It is not sufficient to assert that the equipment was calibrated: it is not impossible for calibrated equipment to malfunction for short periods of time or for people using the equipment to make errors. Because no explanation has been provided, these CO data should be regarded as unreliable.

12) AEB hydrogen chloride monitoring results: Response 15 to my 28 August comments does not explain the plateau at 43.5 ppm from monitor 86923. Perhaps the problem with this monitor is related to the troubles encountered in attempts to do multi-point calibrations. (See page C-2 of the USAEHA report.) The response also does not address why this monitor gives a peak reading of 43.5 ppm while the USABRDL monitors give peak values of 77 to 80 ppm. It does not make sense that the HCl concentration would show no variation from the peak value of 43.5 ppm for over 100 seconds. I conclude that the data from monitor 86923 are unreliable and that the peak instantaneous HCl concentration should have been given as 80 ppm in Table 10.

13) methodology for calculating average HCl concentrations: Response 16 to my 28 August comments indicates that, "The USAEHA is not sure of the applicability of the power law to ambient air monitoring data." This power law methodology was used in the Supplement to the STARS EA and in the STARS DEIS to compute 30-min average and 8-hour average concentrations from 60-min. average values.. The final EIS should have contained a discussion of these different methodologies. It is indicative of the superficial treatment of STARS air quality issues that only now is the USAEHA "coordinating with the U.S. EPA to determine the applicability of the power law to air monitoring data."

14) reliability of GHA-South monitoring data: Response 17 to my 28 August comments only describes the data; no plots are shown. If these data, except those taken near the time of the power interruption, are believed to be reliable, why are the plots not shown?

15) GHA-South HCl monitoring data: Response 18 to my 28 August comments refers to a data page that was not included in the USAEHA report. This emphasizes why it is important to show plots of the data from all monitors at this site. According to the response, the only HCl data page in the USAEHA report is for monitor 86924, whose pump quit sometime during the sampling run. The data page for HCl monitor 86181 was for some unexplained reason not included in the USAEHA report even though the data from monitor 86181 are apparently believed to be reliable. Plots of data from all GHA-South monitors should be made available for review before a decision is made about the Restrictive Easement.

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16) cause of increase in chloride concentrations: Response 21 to my 28 August comments does not dispute my contention that STARS HCl emissions are partly responsible for the increased HCl concentrations in 87% of the soil samples taken after the 26 February STARS launch. However, the response does not address my suggestion that additional monitoring and/or mitigation measures should be considered for future STARS launches.

Sincerely,

Michael Jones

Michael Jones
Physics Dept.
Univ. of Hawaii
2505 Correa Road
Honolulu, Hawaii 96822

copies to: State of Hawaii Office of Environmental Quality Control
U. S. Army Space and Strategic Defense Command
State of Hawaii Dept. of Health

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APPENDIX 3

25 March 1994

Commander, U.S. Army Space and Strategic Defense Command
ATTN: Kenneth R. Sims
CSSD-EN-V
P.O. Box 1500
Huntsville, Alabama 35807-3801

Dear Mr. Sims:

Here are my comments on the December 1993 Final Supplemental Environmental Impact Statement (FSEIS) for Proposed Actions at U.S. Army Kwajalein Atoll (USAKA). The FSEIS was mailed from Portland, Oregon on 22 February and reached me a few days later. Because of the size of the FSEIS, I urge you to extend the deadline for comments beyond March 28.

There are several serious deficiencies in the FSEIS. The most egregious is the refusal to consider an alternative that involves reduced testing associated with national missile defense. The discussion of air quality is self-serving and misleading. Examination of the likelihood of missile failure and of the consequences of such failures is inadequate. Finally, there is no evaluation of the cumulative impacts of lead emissions on soil and water quality and assertions that lead releases from rocket launches are not reportable contradict previous environmental studies, including studies done by the Army Strategic Defense Command.

The detailed comments below refer primarily to the responses to my comments on the DSEIS contained in Volume II of the FSEIS.

1) The response to L1-2 indicates that "NEPA only requires consideration of reasonable alternatives; i.e., those that will achieve the federal agency's purpose and mission." Even though arguments about the mission of BMDO may be outside the scope of this EIS, the implications of the redirection toward theater missile defense indicated both by Defense Sec. Aspin's 13 May 1993 announcement and by the October 1993 Defense Department "Bottom-Up Review" are that it is reasonable to expect reduced activity on national missile defense. Refusal to consider an alternative involving reduced activity on national missile defense is unreasonable and irresponsible.

2) The response to L1-3 asserts that "in-depth analysis" of START II treaty compliance issues "is not appropriate for duplication in a NEPA document." However, the conclusions of the analysis are relevant because bans or limits on some types of missile tests could substantially reduce the numbers of future tests. This would directly affect the future level of missile testing activity and thus should have been considered.

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3) The response to L1-4 compares the chlorine emitted into stratosphere by USAKA launches with a more realistic schedule of Shuttle and Titan launches and concludes that the relative contribution of USAKA launches would be about 50% at the high level of activity. It is self-serving to suggest that the ozone depletion that will result from the USAKA launches is not significant because it is a small fraction of the total chlorine burden or of natural sources. Any single source is a small fraction of the total. The appropriate response to international efforts to phase out use of ozone-depleting chemicals is to evaluate all substantial sources and to reduce or eliminate them. An increase in chlorine resulting from USAKA launches is significant because it is counter to international efforts to reduce ozone depletion.

4) The responses to L1-5 and L1-6 contain corrections for errors in some of the tables of the DSEIS. There is no explanation why the annual lead emission for Roi-Namur was listed as 5.75 tons in the DSEIS if the correct value is 0.0358 tons. The corrected tables titled Summary of Calculated Potential Pollutant Emissions (Tables 4.4-4, 4.4-10, 4.4-15, and 4.4-20) are misleading because they apparently do not include emissions from rocket launches. For some pollutants, the rocket emissions are the dominant source. For example, the 8 sounding rocket launches from Roi-Namur indicated in Table 4.4-5 would emit a total of 384 pounds of lead which is much larger than the 0.0358 tons (71.6 pounds) listed in Table 4.4-4. Another example is the amount of carbon monoxide on Illeginni, which is given as 31 tons for the intermediate level of activity (Table 4.4-15) whereas the 20 launches envisioned would emit over 150 tons annually.

5) The response to L1-7 contains useful and relevant information about previous launch failures. It also concedes that "There have been in the past, and will be in the future, failures of these experiments." It is precisely this kind of information that should have been included in the text of the FSEIS instead of misleading statements like, "No adverse experience has occurred in use of older motors in recent test flights." (See page 4-274.) In addition to the failures I cited in my 15 May 1993 comments, there was an even more serious failure of a Minuteman I launch at Vandenberg on 15 June 1993. The missile had to be exploded about 8 seconds after liftoff. The flaming debris started brush fires that burned 400 acres on the base plus 600 acres off base. This failure should have been mentioned and the consequences of a similar failure at USAKA should have been assessed in the FSEIS.

6) The response to L1-8 refers to Figure 4.15-3, which shows expected debris areas for TMD intercepts. The target debris area for intercepts from Illeginni touches protection circles for three island groups. This provides very little margin of safety. Alternative sites for these TMD tests should have been considered.

7) The response to L7-1 cites the Missile Defense Act of 1991 as justification for levels of missile testing greater than those analyzed in the 1989 EIS. The response does not mention amendments to the Missile Defense Act that have substantially reduced the

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urgency and scope of the national missile defense effort. Because of these amendments and recent Defense Dept. directives which have reduced the priority of national missile defense, the FSEIS should have examined an alternative of reduced testing associated with national missile defense.

8) The response to L7-2 indicates that values appropriate for the Talos rocket motor are now being used for the emissions of sounding rockets in the tables of rocket launch activity. Use of the Talos means that the lead emissions from sounding rocket launches are larger than other sources on some islands. For the intermediate level of activity, eight sounding rocket launches will emit 384 pounds of lead each on Roi-Namur and Meck compared to the quantities of 77.4 pounds and 2.1 pounds respectively indicated in Table 4.4-15.

9) impacts of lead releases: The response to L7-3 and the addition to section 4.4.1 of the FSEIS contain an evaluation of the air quality impacts of the lead release from Talos launches. However, there is no evaluation of the cumulative impacts of the lead emissions on soil or water quality. The July 1992 Environmental Assessment for the Kauai Test Facility noted that elevated levels of lead were found in soil samples taken near some of the launch pads. A similar soil sampling survey should be done around USAKA launch pads and the cumulative impacts of lead emissions from future launches should be evaluated before the record of decision is issued.

10) reporting of lead releases: The last sentence of the response to L7-3 states, "It should also be noted that the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) reporting requirements for lead do not apply to rocket launch emissions." This statement directly contradicts assertions in previous environmental analyses of launches of rockets that emit lead in the exhaust. For example, page3-5 of the ZEST Environmental Assessment (which is referred to in the response to L7-3) contains the following statements about the 48 pounds of lead emitted by the Talos booster:

"Lead is a controlled pollutant under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), which requires that if the total lead release exceeds one pound it must be reported. Lead releases for ZEST launches will be reported to the National Response Center (NRC), the State of Hawaii, and local response centers."

Another example comes from the Army Strategic Defense Command's 1992 Draft EIS for Strategic Target System (STARS) launches from the Kauai Test Facility (KTF). This document points out that Terrier, Talos, and Nike rockets have released reportable quantities of lead. Page 3-44 contains the following statements:

"KTF has notified the National Response Center as required by the regulations whenever total lead releases have exceeded 0.4 kg (1 lb). KTF personnel have complied with all

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of the notification requirements and will continue to comply with respect to reportable quantities released from future launches."

The Army Strategic Defense Command was also informed that lead releases above the CERCLA threshold are reportable even if lead is not an exhaust product. A 24 February 1992 Sandia letter from Eric J. Schindwolf to Lt. Col. A. C. Manguso of the Army Strategic Defense Command (document 247 of the Strategic Target System EIS Administrative Record) points out that the cutting charges for STARS flight termination and stage separation contain over 4 pounds of lead. This letter further states, "It is SNL's understanding that the appropriate quantity will have to be reported as being released to the environment for each STARS I or STARS II launch, similar to the current practice for other launches at KTF which have lead content."

The CERCLA threshold quantity for reportable lead releases was increased from one pound to ten pounds in June of 1993, but the lead releases from the Talos and Terrier rockets exceed the ten-pound threshold. The response to L7-3 should have explained why the Army is contradicting previous documents and is now asserting that CERCLA does not apply. If the Army is claiming an exemption based upon some new provision in CERCLA, the basis for this exemption should be cited. It should also be stated whether (and to whom) lead releases from previous launches at USAKA have been reported.

11) The response to L7-4 indicates that the location of Wake Island has been added to Figure 4.15-1 but does not explain why the Hazard Area (which includes Wake Island and the target and interceptor debris areas) indicated on Figure 4.14-1 of the 1989 Draft EIS is not indicated on Figure 4.15-1. Also, Figure 4.14-1 contains solid dots inside the target and interceptor debris areas at locations where one might have expected the target and interceptor to have impacted if they have missed each other. The response to L1-8 states that the locations of these impact points are not shown in Figure 4.15-1 "for security reasons." It is hard to believe that showing the locations of these impact points would compromise national security, especially since they were already shown in the 1989 Draft EIS.

12) The relative concentrations of carbon monoxide and hydrogen chloride given in Tables 4.4-8, 4.4-13, 4.4-19 and 4.4-24 appear to be inconsistent with the total amounts per SLV launch as given in Table 4.4-9. This table indicates that each SLV launch emits 15,752 pounds of carbon monoxide and 11,416 pounds of hydrogen chloride. One would therefore expect that the hydrogen chloride concentration would be less than the carbon monoxide concentration, but the tables of predicted concentrations give hydrogen chloride concentrations over 50 times greater than the carbon monoxide concentrations.

13) My final comment refers to the regulatory mechanism in the proposed USAKA Environmental Standards and Procedures. Replacing the letter of authority mechanism which the Marshallese thought had been accepted by the record of consultation has

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justifiably offended the Marshallese. It represents another shameful betrayal of the trust the Marshallese have shown. The letter of authority mechanism should be reconsidered as recommended by the U.S. Environmental Protection Agency in comment L9-6.

Sincerely,

Michael D. Jones

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2505 Correa Road
Honolulu, Hawaii 96822

copies to: Sen. Daniel Inouye
Rep. Patsy Mink

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P.O. Box 1474
Sitka, Alaska 99835
May 29, 1994

Major Tracy Bailey
Ballistic Missile Defense Organization
P.O. Box 4140
Gaithersburg, MD 20885-4140

Dear Major Bailey:

001 As a victim of what I consider remote laser or radar hits obviously since August 1992, I would hope that any testing or research on our defense system would not include tests which would possibly hit human beings or animals.

I have experienced these painful, possibly destructive, bits of sadism in Anchorage, Alaska in the early 80s to my lower back, in American Samoa's Pago Pago harbor as stinging eyes when I lost my sunglasses and have experienced same in the USA. In Seattle, Washington on south to Bishop, California in 1992 I experienced in my vehicle pain and tearing and change of ocular vision which has recurred but has proven to be temporary. I was forced to stop in a rest stop and protect my face and body with my portable computer in Washington State. In Bishop at my dying mother's house I had to sleep nights with a file cabinet drawer over my head.

In San Diego county in 1993 I was hit in the head in Pala Campground, first with a numbing sensation, then one which disoriented me. I drove back to Washington, D.C. shortly after to have a constant hit in my head at Lake Tenkiller, Oklahoma, my left temple. I believe I am part Cherokee Indian. I believe there was symbolism involved there. I took a wrong turn in a heavy rainstorm and ended up in the middle of the night in a rest stop in Pennsylvania. I was hit so hard there that I nearly lost control of my limbs, did for a second or two.

I was not so well organized and so I didn't accomplish much except being hit in the head again, seemingly for typing on my computer, in a campground in Northern Virginia. What I did accomplish was to find information on laser weapons being used in war games, this in the local library. I have also had mysterious interruption of operation of my automobile, hair dryer and scrambling of my computer's processes, metal locking on metal. Part of the war games? This began at that time, first to my automobile's starting mechanism as I recall.

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BMDO/May 29, 1994
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Back in San Diego I continued the research on mind control I had begun earlier in the year in Juneau, Alaska. I was walking towards my car one day when I felt pain in my upper backbone which loosened the vertebrae to the point I had to push them back in, this for the second time. I was reading Laser Weapons and my eyes were punished to being bloodshot. From time to time my breasts were, and continue to be, hit to burning or pain. My stomach/abdomen and head were hit during the winter in Mexico so painfully I put my computer first to protect one, then the other, location, on two different nights. Since I lived in Samoa I have had an internal tenderness and pain because of a lesion in one area to the point sex is extremely painful, would be if I continued to engage in the practice. In Mexico I received what I consider to be a laser rash.

In San Diego and Mexico I wrote to UCLA to threaten lawsuit and those heavy hits ceased. I chose that place (UCLA) because my brother and sister-in-law, as well as many friends and acquaintances, have attended UCLA and I had a sense there was a connection to El Toro Marine Base. After the Laser Weapons incident I wrote to a famous lawyer for help. He usually handles defense cases and was not at that time interested but the punishment ceased for a while, until Mexico. When I was hit in Mexico I wrote to the Department of Defense and my life was saved I believe.

My eyes are being burned as I write this. The left side of my brain and body seemsto be the target of destruction. Before my father and mother died, his mind was taken and her body wrecked. Other older members of my family are currently being persecuted at this time. Those being persecuted are on the Indian side of my family. My grandfather on that side was a U.S. Sheriff or Marshall. We didn't grow up on a reservation but it seems that our family may have been chosen by some subversive group which has access to sophisticated weaponry via the Department of the Interior, possibly via their computer system. I wonder how many other families suffer a similar persecution in the name of "testing" because they do live on a reservation, in a VA hospital, are handicapped.

002 This letter may not be well-targeted to the BMDO but I hope you will, in your research and development processes, take into special consideration that some small facet of the process might be intercepted and used by a subversive power/group, especially anything which could be voice, thought, or feeling controlled as is being currently tested in the aircraft industry, at Wright Patterson Air Force Base in Dayton, Ohio.

Thank you for your continued attempts in making our world a safe place to live.

Yours sincerely,

T.C. Holly Jenkins

PRESS RELEASE

The Ballistic Missile Defense Organization (BMDO) announced on April 15, 1994 that it filed the Draft Programmatic Environmental Impact Statement (DPEIS) for the continued research and development of a Ballistic Missile Defense (BMD) system capability by the Department of Defense (DoD). BMDO will sponsor two public hearings to provide the public an opportunity to present their comments on the DPEIS. The first public hearing will be held on May 10, 1994 at 7:00 PM at The University of California, Santa Barbara Campus, Girvetz Hall, Room 1004, Santa Barbara, California. The second public hearing will be held on May 12, 1994, at 7:00 PM at The National Guard Association of the United States "Walsh-Reckord Hall of States," 1 Massachusetts Avenue, N.W., Washington, DC. Verbal comments will be limited to 5 minutes. Translators and signers will be provided upon request by calling the toll-free number listed below. Additionally, comments may be provided through the following means:

Written comments and questions concerning the DPEIS may be forwarded to: Major Tracy Bailey, BMDO, P.O. Box 4140, Gaithersburg, MD 20885-4140. **All comments must be postmarked by May 31, 1994.** Written comments and questions may also be telecopied by calling toll-free (800) 636-2636. Copies of the DPEIS or Executive Summary may also be requested by calling the above toll-free number. Verbal comments (5 minutes) will be recorded by calling toll-free (800) 636-2636 from April 15-May 31, 1994.
For the hearing impaired, the toll-free number to comment is (800) 653-2150.

The PDEIS was prepared in compliance with the National Environmental Policy Act and evaluates the potential environmental impacts for the continued research and development of a BMD system capability by DoD. The Preferred Action is the ongoing Technology Readiness Program for National Missile Defense (NMD). The objective of the Program is to research and develop long-lead time sensor, interceptor, and battle management/command, control, and communications technologies to provide improvements to existing missile defense capabilities. In addition, concepts for NMD, contingency deployment will also be enhanced. The Preferred Action is also the No-Action Alternative. Alternatives to the Preferred Action analyzed in the DPEIS would also proceed with research, development and testing activities; however, at a more intense level of effort. In addition, these three alternatives would also allow for the acquisition of 1) all Ground-based, 2) Ground-and-Space-based sensors and Space-based interceptors, or 3) Ground and Space-based sensors and Ground-based interceptors NMD, respectively. These alternatives would proceed to development of system capability.

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IN THE NEW WORLD OF BRAIN-ACTUATED TECHNOLOGY, YOU'LL FLY A PLANE, PLAY A VIDEO GAME, OR MANEUVER A WHEELCHAIR JUST BY THINKING ABOUT IT.

BRAIN POWERED

BY BENNETT DAVISS

PHOTOGRAPHS BY MAX AGUILERA-HELLWEG

In a windowless, cavernlike laboratory, David Tumey wriggles into a steel box, about the size of a large refrigerator, that is mounted on a four-foot horizontal shaft and connected through a computer to an electrical control system. The box is an ordinary flight simulator, much like some two dozen others found here at Wright-Patterson Air Force Base near Dayton, Ohio. On the wall in front of Tumey, a small video screen displays a line representing the horizon. A heavier black bar sits atop that line, indicating the simulator's angle relative to the horizon.

By mapping David Tumey's brain activity, researchers hope to learn how he can control matter with his mind

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Suddenly a green line appears, at a different angle from the simulator's black bar. It's Tumey's job to try to bank the simulator so that the green line covers the black bar—in other words, he needs to bank the simulator either to the right or to the left, so that the two lines are tilted at the same angle. He does so easily. But Tumey's feet aren't resting on pedals, and he holds nothing besides a limp scrap of paper that he's been fingering just to give his hands something to do.

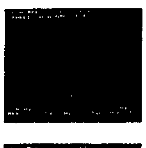
Tumey is controlling the simulator just, in effect, by thinking about it. Researchers at Wright-Patterson's Alternative Control Technology Laboratory call this brain-actuated control. They and like-minded researchers around the world are learning how to take the electrical impulses given off by the brain's neurons and use them to control computers, motors, and other devices. In a number of different trials, people have learned to turn lamps on and off, channel surf on TV sets, and play video games without the use of hands or voice. All they use are a few well-placed electrodes and their power of will.

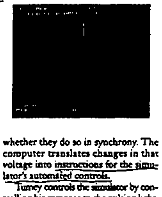
You might call it a case of mind over matter, but the scientists involved aren't comfortable with what the phrase implies. "People have the idea that this technology reads subvocal thoughts—that you think the phrase 'Close the door' and the door will close," says electrical engineer Andrew Junker, who first developed the Wright-Patterson program. "That's not it at all. At this point we're measuring electric signals, not reading minds."

"*All* control is brain-actuated control, as far as we know," adds Grant McMillan, who heads the Alternative Control Technology Laboratory. "All we're doing is measuring the output at a different point."

The signals from Tumey's brain that are being measured are evoked by two soft white lights—one on each side of the simulator's screen—that pulse in unison in a steady rhythm, at the rate of 13.25 cycles per second (or 13.25 hertz). It's a fast but detectable pulse—more like a flicker. Neurons in Tumey's visual cortex, a section of gray matter near the scalp at the back of the head, are stimulated by the pulsing light and give off quick bursts of electricity with exactly the same frequency. Electrodes resting on Tumey's scalp just above the visual cortex measure the strength, or voltage in microvolts, of that precise rhythm, which varies depending on how many neurons are firing and

Right: David Tumey's brain waves, responding to a light pulsing at 13.25 cycles per second, are used to control a flight simulator. By suppressing his response to the light (below, top), Tumey banks the simulator to the left. By enhancing his response (bottom), Tumey banks the simulator to the right.





whether they do so in synchrony. The computer translates changes in that voltage into instructions for the simulator's automated controls.

Tumey controls the simulator by controlling his response to the pulsing light: by suppressing the rhythm in his visual cortex below a fixed threshold, he banks the simulator left; by enhancing his brain's rhythm above another, slightly higher threshold, he banks it right. If the voltage falls somewhere between the two thresholds, the simulator stays put. Tumey sees how he's doing by watching the green line pivot against the black bar.

HOW CAN TUMEY SUPPRESS OR INtensify the voltage of a specific electrical frequency in his brain? "No one really knows," says John Schnurer, a physicist working on the Wright-Patterson project. "Just as with any learned response, the exact mechanism is difficult to put into words. We've asked subjects to fill out questionnaires, and their response makes it clear that the more successfully they can control the simulator, the less able they are to explain how they do it."

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WOLPAW'S VOLUNTEERS WERE ASKED TO THINK ABOUT SOMETHING—ANYTHING—THAT WOULD ALLOW THEM TO MOVE A CURSOR TO THE TOP OR BOTTOM OF THE SCREEN ON COMMAND.

Tumey, who has logged more time in the simulator than anyone else, doesn't know either. "At first you think of physical images, like pushing and pulling or opening and closing. That didn't work very well for me, and one day I just said the heck with it. Once I just let go and started to let it happen instead of trying to *make* it happen, I got better control. It was almost like a psychic experience."

Of course, it may not really matter *how* Tumey does what he does. "It's not a question of the brain's ability to learn this kind of control," notes Jonathan Wolpaw, a neurophysiologist with the Wadsworth Laboratories, which are part of the New York State Department of Health. Wolpaw is trying to use the technology to give people who have little or no control of their limbs, voice, or even their breathing a way to control their surroundings. "I'm fairly sanguine that the brain can learn far more than we have the skill or knowledge to teach it. The hard part is learning how best to implement this technique."

The hard part, in other words, is finding the answers to the somewhat mundane technical questions: how many electrodes to use in reading brain signals, at which points along the scalp's surface those electrodes should rest, which electrical frequencies to read, how to sort one signal from another. The human brain holds somewhere between 10 billion and 100 billion neurons, which form as many as 100 trillion connections among themselves. The electric signal that is at the core of any mental or physical process—voluntary or involuntary, no matter how minor—comes from each of millions of neurons picking up a chemical signal and translating it into an electric pulse that travels down its long, threadlike axon until it reaches the next neuron. Every thought, reflex, or sensation triggers such an electric pulse. Trying to pick out one useful signal from the activity of millions or even billions of neurons is much like attempting to eavesdrop on a single conversation by holding a microphone over a large city. And on the brain's information highway, the traffic is as constant as it is noisy.

The good thing for the researchers is that much of that traffic travels in convoys. Although individual neurons pulse with electricity, it takes groups of neurons working together on a common task, or even resting together, to put out a pattern—a wave—that's loud enough to be detected. Different types of activities result in waves with different frequencies. For instance, delta waves—which are most evident during deep sleep—have frequencies between .5 and 4 Hz. Theta waves also arise during sleep, during its dream stages, and have frequencies between 4 and 7 Hz. Alpha waves span the frequencies from 8 to 13 Hz and are given off by a wakeful but relaxed brain. Finally there are the beta waves, which have frequencies between 13 and 30 Hz. These are the waves that result when you do something that requires real concentration—balancing your checkbook or writing a research paper.

TO PUT TOGETHER THEIR BRAIN-actuated technologies, researchers first have to choose a single wave from among the brain's electrical torrent and then learn how to track it. Wolpaw, for one, looks at recordings of brain waves taken by an electroencephalograph (EEG) while his test subjects—usually volunteers from other, nearby labs—are sitting quietly in a chair. What he's measuring is a subset of alpha waves known as mu waves. Mu waves arise at different frequencies within the alpha bandwidth of 8 to 13 Hz; they're the resting rhythms generated by the neurons in the sensorimotor cortex, a strip of brain geography that lies on top of the head between the ears, almost like a headband. "My waves change in response to sensation and movement," Wolpaw explains. "This seems to be the part of the brain most directly related to our normal channels of physical control, so we thought it might make sense to use these waves to develop this new control channel."

Wolpaw and three colleagues screened 60 normal adult volunteers and selected the five whose mu rhythms were the easiest to read. Then Wolpaw sat them in an easy chair in front of a computer screen and fitted them with what looked like a bathing cap studded with electrodes. Their assignment was simple: they were asked to think about something—anything—that would allow them to move a cursor to the top or bottom of the screen on command. Each of the five underwent half-hour practice sessions three times a week for two months. The ideal, says Wolpaw, "is to try to approach as closely as we can the speed and accuracy of control over a computer that you get with a mouse."

The researchers monitored the mu rhythms until they found each individual's best wave—the wave they were best able to control and which they could then use to move the cursor. "Presumably," says Wolpaw, "general sites and frequencies are common to most people, although we can't really say yet what they are. However, we'll probably always have some customization within set limits for each patient—finding the precise frequency or electrode placement."

One subject was completely unable to get a mental grip on the cursor, but the other four were ultimately able to hit the target 80 to 95 percent of the time. In less formal tests, these same subjects have been able to use their minds quite deftly,

One of Jonathan Wolpaw's test subjects—a man with Lou Gehrig's disease—is wired up to an EEG machine and a computer that will translate his resting brain waves and use them to move a cursor across a computer screen.

Could this have been initiated with remote help (electronic flow)?

maneuvering the cursor over on-screen bars that, when contacted, turn lamps on or off or change the channel on a television set. Like Tumey, however, even the most proficient cursor movers are not able to explain exactly how they do it.

Wolpaw is now taking the next step: with a five-year grant from the National Institutes of Health, he is fashioning his technique into a sort of mental prosthesis for people who don't have the use of their limbs. He hopes eventually to enroll 100 people in his study, about a quarter of whom will have some significant disability. His first test subject, for instance, was a man suffering from amyotrophic lateral sclerosis—otherwise known as ALS or Lou Gehrig's disease. Wolpaw says his ALS patients appear to be able to learn to move the cursor just as ably as those without any disability.

Andrew Junker's assistant steers a wheelchair. The signals picked up from her forehead are fed into the laptop computer on the table in front of her, analyzed, and sent on to the chair's controls.

Actually, what has hampered progress in brain-actuated technology is not the speed at which the brain adapts to these new methods of controlling the environment. The speed bump along the learning loop is in the hardware itself: conventional computer programs take too long to analyze the EEG, carry out commands, and show the result to the test subject. "If you told your arms to turn the steering wheel on your car and nothing happened for ten seconds, you could still drive, but you'd have to drive really, really slowly," says Schnurer at Wright-Patterson. "We have to give test subjects feedback in as close to real time as possible, in order for them to be able to learn this control in a meaningful way. Without it, the brain can't associate a particular effort with a particular result, and it begins thinking about other things."

In real time, a visually evoked response—the amount of time it takes for you to see something and respond to it—takes about .07 second. Schnurer considers that sliver of time a personal challenge. In 1986 he built an electronic signal processor that can home in on any selected brain frequency, lift it out of the brain's electrical traffic flow, and begin to speed information about its variations back to the flight simulator's screen in .2 second.

That, says Schnurer, isn't nearly good enough. It's the signal processor's fault. It has a built-in time delay—a bottleneck inherent in the filter that picks up the pulses of brain activity and has to smooth them out into a steady signal the computer can use. He has been hard at work on a new signal processor—which includes three processors working at once, as well as some speeded-up circuitry—to significantly cut into this time delay. The goal is to slash the total response time to as little as .1 second. "If the brain completes a cycle," says Schnurer, "and we can show it what it did before the next cycle is over, that's about as close as you're going to get to instant feedback."

Gert Pfurtscheller, a biomedical engineer at the Graz University of Technology in Austria, has decided to get rid of the bottleneck altogether: the process would be much simpler, he believes, if you didn't have to bother showing the brain what it's doing. In his scheme there are no video screens; the brain sends out a command, and the computer acts on it.

In other words, rather than teaching the brain how to control a computer, Pfurtscheller has decided to let the brain act naturally—let it generate its usual, spontaneous wave patterns—and let the computer do all the learning. His immediate goal is to teach a computer program called a neural network—a program that, like the human brain, is designed to draw conclusions based on patterns in the data it's fed—to predict which physical movement a person has decided to make according to the EEG pattern the brain is generating. "We've found that mental preparation for a specific physical movement creates a specific EEG pattern that is recognizable in all subjects," he explains. "This specific pattern is also clearly different from that created by the mental preparation for a different movement."

Pfurtscheller starts with a short list of movements—pressing a button with the right or left index finger, pointing the toes of the right or left foot up or down, placing the tongue behind the teeth as if preparing to pronounce the letter *t*. To give the computer enough data to work with, he has his test subjects repeat one or more of these movements hundreds of times over three or four hours. Each time, says Pfurtscheller, the brain has to prepare itself to make the movement, and that preparation takes between half a second and a full second. A second's worth of hesitation seems like a long time, but according to Pfurtscheller there's a difference between the preparation for this sort of conscious decision—the decision, for instance, to say the letter *t*—and the preparation for a more programmed, automatic skill like using the letter *t* in speech. The chosen movements are discrete, voluntary movements, he points out, "not the movements involved in things like typing or playing the piano, which are part of a subconscious pattern."

During the warm-up time for each single, deliberate act in Pfurtscheller's list, the brain creates a recognizable EEG pattern at a specific brain location. Over time, the neural network learns to recognize the differences in the EEG patterns that occur before each movement and

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thus can predict which is about to occur.

Finding these prescient patterns isn't easy: they don't exist among the brain's well-charted electrical pathways—that is, among brain waves with a frequency below 30 Hz. Most EEG researchers don't even bother looking at brain waves above that: higher frequencies are difficult to pick up and are easily lost amid all the rest of the brain's noise. But Pfurtscheller—expanding on work done by European and U.S. researchers—has learned how to reliably isolate and read 40 Hz signals directly off the surface of the scalp. And that's where he found what he believes to be the electrical signature of the brain's preparation for physical movement.

"When you plan a movement of a right finger, there is an increase in 40 Hz activity over the portion of the brain's left hemisphere that controls the hand; when you plan a left-finger movement, the same pattern occurs in the reciprocal place over the right hemisphere," he says. "These patterns are quite different for each specific type of movement, but they are repeated in the same test subject on different days."

Now that he's snared himself a good, reliable brain wave to monitor, Pfurtscheller intends to use it to help people paralyzed by spinal-cord injuries. His first project is based on technology already in use by paraplegics—an electronic stimulator that gives them bladder control. When the patient presses a button, the device stimulates his bladder and he urinates; when the button isn't being pressed, there is no urination. The device has given paraplegics the ability to urinate when and where they choose—an important bit of independence.

"But what if the person has no use of his hands?" Pfurtscheller asks. "If he can't move his hands, he can't press a button." So in a three-year trial just now beginning, Pfurtscheller's research group will attempt to give such patients bladder control through the use of neural networks able to interpret their desires. "Of course, it's too complicated to read abstract thoughts," says Pfurtscheller. Instead he envisions using a neural network through which a patient might activate an electrical bladder device by mentally preparing to point the toes of his right foot up and then turn it off by thinking about pointing the left toes down.

Eventually, Pfurtscheller hopes his technique could be extended to give paraplegics mental control of electrical stimulators now being implanted experimentally in leg muscles. These stimulators provide the electrical impulses no longer being delivered by the nerves and, in theory, allow the patients to walk. But the only way for the patients to control the speed and direction of their steps is by pressing buttons on a computer that hangs in a box from their shoulders or trails behind them in a cart. Pfurtscheller's neural network could ultimately give them control over the computer that controls their steps. "We have done the basic work," he says. "We need now to do the experiments and improve the basis that we have set down."

ONE RESEARCHER SEEMS TO HAVE already begun. Five years ago Andrew Junker left the Wright-Patterson laboratory he created to pursue new ideas about brain-actuated technology. And he's obviously onto something. He's used his device—a narrow cloth headband that holds three postage stamp–size electrodes, and some proprietary software that can translate what the electrodes pick up—to steer his 35-foot ketch, *Gypsy Moon*, and to maneuver a wheelchair. A quadriplegic in Pittsburgh has used it to play video games. Musicians in Albany and Philadelphia, alone or in groups, have used it to play a flute, a double bass, and an organ in the normal way while mentally improvising harmonies or counterpoints on an electronic synthesizer.

Junker's advances seem to put him head and shoulders above the rest of the brain-actuated technology crew. But some of them say that he's not really working in the same field. The problem, they say, is that electric signals picked up from the forehead are not pure brain waves—they're littered with signals from the head, neck, and shoulder muscles. "The forehead is a great place to read muscle activity," says Wolpaw, "and that makes it a terrible place to read brain activity."

Junker doesn't disagree. "Those muscle signals are known as 'artifact,'" he explains. "To a trained archeologist, an artifact is a very valuable thing. But often, the way EEG researchers deal with the appearance of artifact is to shut off their machines because they regard it as noise." Junker puts it to use: he considers the signals to be like training wheels, a means by which a person can gain quick control of a task using the more easily manipulated muscle signals, then gradually develop the more subtle brain-actuated control at leisure. "Everyone knows that the brain-body link is there, but most researchers try to work around it," he adds. "We embrace it."

The question, however, is just what role brain actuation plays in Junker's creation. Wolpaw believes that Junker's machine may be nothing but an elaborate muscle switch—a common device that translates movement or tension in a muscle into commands that activate mechanical or electrical devices. "If you're interested in getting a new kind of control for someone who can control only his forehead muscles or his neck muscles, then that's just fine," he says. "But if he can't, then it's not fine. If you have someone who has totally paralyzed muscles, then muscle activity isn't going to work."

While Junker contends that brain waves play an integral role in his device, he freely concedes the presence of muscular electricity in its signal. "The bottom line is that it doesn't matter, as long as people can use it to enhance their quality of life," he says. "The point is, you can't have muscle activity without brain activity. The dilemma for the scientist is how to separate those two. And they can't be separated easily, if at all."

McMillan's lab recently awarded Junker a research contract to try to help him untangle brain signals from muscle signals within the cascade of data his machine collects. "From a scientific point of view, we would like to know exactly what's going on," says McMillan. "But it doesn't necessarily mean the device isn't useful, even if we find out it's purely muscle."

"What's important is that this works," Junker adds. "Typical biofeedback experiments require several sessions before a person gains minimal control. Our device gives most people some sense of connection to the task, and even a degree of control, within a minute or two."

The scientists involved in brain-actuated technology do a lot of blue-skying when talking about advances in their field. Take Tumey, for instance. David Ingle, one of the Wright-Patterson engineers, says that Tumey's mental control of the simulator is so good "he'd have no problem handling the control stick of a Piper Cub." It will undoubtedly be a while before he has the chance—the technology will first be used for tasks that won't endanger anyone's life, such as scrolling a computer display or choosing items from an on-screen menu. "But who knows?" says McMillan. "Twenty or thirty years from now, we might be saying, 'Gee, I'd never want a pilot to control the stick with his hands when he can do it so much better by manipulating his brain activity.'"

DATE: May 29, 1994

MEMORANDUM TO: Major Tracy Bailey, BMDO

FROM: Walter F. Hallett

SUBJECT: BALLISTIC MISSILE DEFENCE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, APRIL 1994

SECTION: Chapter 3.0 Affected Environment;

SUBSET: Land Use (Section 3.12) Geology, Soils and Prime and Unique Farm Land (Section 3.14)

SECTION: Chapter 4.0 Environmental Consequences

SUBSET: Geology, Soils and Prime and Unique Farm Land (Section 4.14 Through 4.14.3).

This section concerns itself with soil surface disturbance and soil exposure from grading and construction; off road travel, etc.

SUBSET: Later Life-cycle Phases (Section 4.14.2.2).

This subsection delineates the probability of grading right of ways several miles in length; installing utilities or fiber optic cable serving or linking ground based facilities.

SUBSET: Mitigation Measures (Section 4.14.1.2)

This subsection sets forth seven (7) erosion control methods for disturbed soil, with two (2) of the methods being the more important:

a. Applying temporary seeding, etc., etc.

b. Permanently seeding exposed soils after completion of ground-disturbing activities.

It is to these two methods that I would like to address the following remarks.

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c. Ground based systems and/or sensors would most likely require construction of basing sites. Where these sites to be connected together by a ground based telecommunications buried cable systems, a right-of-way would then be required with a consequent need for right-of-way seeding as outlined in the following philosophy.

001

d. This philosophy of right-of-way seeding and mulching was prepared as part of an analysis of a contractor cost proposal for repair of buried communication cable right-of-way of Wing 5 of the Minuteman Missile, Cheyenne, Wyoming. Most of the requirements incorporated in this paper were based on Army Corps of Engineers requirements as well as that expressed in the final paragraph of Section 2.

Document 0051

PERSONAL BACKGROUND

March, 1962, selected as a member of a SATAF (Site Activation Task Force) from McClellan AFB, Sacramento, California, at Ellsworth AFB, Wing 2, Minuteman Missile System, Rapid City, South Dakota. Worked in both field and base office.

September, 1963, transferred to SATAF Wing 5, at Cheyenne, Wyoming. Worked both field and base office. A primary task was review and analysis of contractor cost proposals for working at missile sites.

At completion of Minuteman Missile work Wing 5, was selected by the Naval Air Systems Command to a position in contract administration.

Retired in 1983 from the Department of Defense with a combined total of 41.5 years service.

Walter F. Hallett

Walter F. Hallett
9910 Marquand Drive
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PHILOSOPHY OF SPECIFICATION REQUIREMENTS FOR SEEDING AND MULCHING - PURE LIVE SEED AND NATIVE GRASS HAY

1. Seeding: Specification quotes description of seed mixtures and quantities and adjustment to different type soils. Seed mixtures are explicit on use of Pure Live Seed for a basic reason.

a. Cable system covers areas from 6000+ foot altitude to elevation several thousand feet lower. Soils encompass a range from sandy loams, loamy clays, sandy clays, to almost pure sand.

b. Seed mixtures are based on the toleration of certain types of growth to certain soils and the fact that certain soils will not sustain growth of some seeds. Seed mixes are therefore of such type that when planted to their adjusted area, a growth will be experienced and throughout continuing time will be maintained.

c. Seed mixtures contain one or two basic grass types, primarily wheat grass, whether the crested, western, or pubescent type, or combination of types for this purpose: These seeds are primarily a warm or hot weather grass and will grow almost anywhere or anyplace without problems. This can be proven by the fact that the area of the cable system is located in a wheat grain-growing belt. The fact remains, however, that wheat type grasses will tend to disappear from range or pasture land areas over a period of time. For this reason, other seeds are added to these mixtures to provide grass over a long time span. These grasses, i.e., blue and/or sideoats gammo, buffalo, prairie sandreed, and sand bluestem mix grasses are typical native grasses in the soil areas to which they are applied by specification. In fact, these are the grasses that were basic to the prairie and continental shelf areas from time immemorial.

We are also concerned here with several other facts: One is land management and the other is range preservation. The cable system in many areas runs through land that has never been anything but cattle country and contains in these areas these same grasses within the bounds of soil types; i.e., loam, clay, sand. We are therefore concerned with retaining certain native grasses on the right-of-way.

d. By planting a mixture with wheat grasses, we get a certain quick growth which retains soil moisture, prevents wind and rain erosion, to a point, and provides cover shade and protection for the more lasting, slower growing, slower germinating seeds. As stated before, these wheat grasses tend to disappear, leaving a growth like that in adjacent and surrounding terrain which is resistant to winds, drought, and animal browsing.

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e. Pure Live Seed is specified for numerous basic reasons. One is that, by using PLS, no extraneous or trash growth is induced into farm lands or ranges where none existed before incursion of the cable system. Second, we will be assured, with almost 100% grass germination, that the remaining successful growth will be equivalent to, again, surrounding terrain. The time span of work throughout subject area covers about two years with a subsequent right-of-way guarantee of another year. Within this time span, which will cover about 8 changes in season, customer purchase of installed facilities and work areas must be accomplished. Where, in the normal constructive manner, everything proceeds as scheduled, a regrowth of grass is a must along construction areas. This is according to specification and customer satisfaction is the only criteria upon which this (grass regrowth) can be judged. Therefore, preparation of seedbed, PLS seeding, and mulching will assure grass growth.

f. Pure Live Seed is, as stated, only those seeds as specified, without the inclusion of chaff, husks, hulls, noxious weeds, and foreign material. The price of this commodity is consequently higher by reason of its purity. PLS germination and purity should therefore be 100%. Seeds can be purchased in several different compositions.

(1) Bulk Seed - a commercial type seed, with normal cleaning, containing husks, hulls, chaff, extraneous materials, and seed foreign to that contained within the package according to package lable. Purity and germination rates are not applicable or pertinent.

(2) Certified Seed - a commercial type seed, cleaned to be free of noxious weeds, most of its chaff, husks, and hulls, and carries a guarantee of purity with a specified germination rate. Purity and germination usually in the range of 90+%.

(3) Pure Live Seed equals Purity multiplied by Germination and the results divided by 100. Cost per PLS equals Bulk Price divided by PLS.

Considering Bulk Seed at 70% Germination and 75% Purity gives a quantity of 4350 ÷ 100 equaling 43.5% growth factor. Other limitations are the ranges of PLS of the seed itself. These ranges may approximate from 30 for sand bluestem mix to 79 for certified switchgrass, Nebraska 28 variety, also depending on quality of available seed. It can therefore be seen that planting of bulk seed can require quantities two to three times greater than the specified 9 lbs per acre to arrive at a PLS seed rating. This fact will give rise to what constitutes a good base seed cost, and indicate that PLS is, in fact, the most economical way to proceed.

2

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g. Since certain grasses grow in limited quantities and may even be restricted to small areas, prices will vary from season to season. Quantities and qualities will also vary by reason of climatological differences between years. Seed mixes for clay and sand soils are different than that quoted for loam. Some of this is due to elevations, soil differences, length of growing season, and availability of moisture from rains and snows. It has been determined by computation of seed mix prices, that clay soil mix will increase by one-third and sand soil mix by one and one-half to two and one-third times over that cost quoted for loam soil mix. It becomes apparent then that soil configuration is a basic fact concerning what mix is to be seeded where. It is conceivable that, during seeding of right-of-way, to remain within the pale of specifications, that seed mix requirements could be changed to suit any one immediate right-of-way area. It has been observed along the cable system that where the trench traverses through a meadow or lower type area, rises through a series of rolling lands to a higher plain area, that loamy, sand and clay soils may be encountered within a short span of distance. Since these seed mixes were designed for the over-all application to specified soil type, good common sense must be applied, within the bounds of seed mix in use and general area soil. Production, by using certain documents provided by the Corps of Engineers, has computed soil areas within Wing V at 34% loam, 31% clay, and 35% sand. So, again, soil configuration is basic to seed quantities and costs, and must be considered in negotiations conducted on costs to be incurred for seeding cable right-of-ways.

3

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2. Mulching:

a. Specification quotes that mulching shall consist of placing a cover of hay over all seeded areas. Material shall be native grass hay. Tame grass hay would be a second preference. Hay should be from soils and climate similar to those in the project area. Hay must be relatively free of weeds. Hay should be primarily of that species of grass quoted in seed mixtures. Feeding quality and age of hay is not of importance or a consideration of quality.

b. From the foregoing, it is apparent that importing hay from outside the project area is not within intent of specification. One reason will hinge on the fact that some grasses and noxious weeds are basic to certain soils and clima tes and should not be imported to other areas.

c. Hay, rather than straw, is specified for mulch for various reasons. One being that, since it consists of those same grasses that will be established through seeding, extraneous, foreign, and trash growth will be held to a minimum. There will also be a certain amount of seed deposited with the soil from the emplaced mulch. Since hay is cut from a growing grass, normally during its final prime growth, it contains desirable qualities that, upon decomposition, impart certain elements and minerals to the soil that are necessary for sustained growth of the planted seeds. Straw, being a ripened growth of a domesticated grain, lacks those qualities that hay contains in abundance. Straw, in certain soils, can be detrimental and, due to to its inherent characteristics, can actually make soil impermeable to moisture by giving soil an adobe effect. Hay, on the other hand, decomposes without side effects and, in the process, creates a certain amount of heat. Since we are restricted in the application of seed to 75 days, more or less, in the spring months and less time, on the average, in the fall, heat generated by decomposition can be beneficial to germination and maintenance of growth during the colder parts of the growth period.

d. Specification states that hay must be distributed evenly without appreciable cutting or breaking of the straw length. In this case, the word "straw" is used in reference to the grass stalk or stem, per se, and not to a grain straw. Specification also allows mulch to be rolled or tamped into the seeded surface. A long stem grass hay will be retained with more success, by being impressed into the ground along several areas of its length, than a short cut length of a grain straw. The area of the cable system is characterized by low precipitation and humidity, high evaporation and wind velocities, sporadic rains and dry snows. For this reason a mat of hay is a must, over all seeded areas, to retain available moisture and prevent wind and rain erosion.

4

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3. Summary:

The Wing V Hardened Intersite Cable System is an intrusion upon the land, just the same as a pipeline, a commercial communication line, or other similar buried facilities. We believe that the customer has a liability to the land, as well as to the land owners and to the posterity of a national heritage. This specification with which we are concerned, was prepared under the best advice possible with one purpose and one thought: To retain and maintain present, former, and future range lands and seeded native pasture land in a viable condition. The customer has, in fact, through enactment of certain public laws, established such agencies as Soil Conservation, Agricultural Stabilization and Conservation, Land Management, Soil Bank, and a host of additional plans and programs of a major and minor nature, to assure the protection and preservation of our landed heritage. We, therefore, believe that the specification for seeding and mulching is a good sound document and should be complied with, as written.

We also believe that, in application to Wing V, and in view of contractor's released responsibilities, Page 5 of 43, Volume IIA of Specification GEEIA-B-80010 should be considered as paramount to and overriding on historical precedent as to landowner satisfaction, individual attempts at deletion or delution of spec contents and abortive compliance with spec intent.

5

Document 0052

29 May 1994

TO: MAJOR TRACY BAILEY, BMDO
P.O. Box 4140 Gaithersburg, Md. 20885-4140

FROM: (Mrs.) Leone Hayes, 5416 Candlelight Drive, La Jolla, Ca. 92037

SUBJECT: BMDO - DPEIS

PRELUDE: The titillating concept of intercepting missiles derives from the years-ago famous Rube Goldberg comic strip. That it was so eagerly espoused by former President Ronald Reagan was not surprising: he is old enough to have seen that the contraptions worked in the comics and observed that other contraptions worked in the movies. Indeed, image-oriented R.R. told Gorbachev that the U.S.A. and then-U.S.S.R. should cooperate to develop the S.D.I. "to protect the Earth should aliens from outer space attack us."

Under the new name, BMDO, highly educated designers and propagators will continue to rely on their very sophisticated science and technology to develop the system. However, in performance this system (as are all others) will be beholden to the Law of Probabilities, Possibilities and Coincidences - the initials of which compress nicely to become LOPPAC*.

FUGUE: LOPPAC influences HITS and MISSES - for instance the less than efficient performance record of interceptor PATRIOT - and leads to questions, answers to which are earnestly solicited:

001

1 - Do I understand correctly that BMD sensors are computer-controlled to release the interceptors toward a source(s) of intense heat? YES _____ NO___

(a) If answer is YES, had the ground-based Phase I of then SDI been installed when Chernobyl exploded, would the sensors have "read" the event as a signal to release interceptors toward this heat source? YES__ NO__

(aa) If YES, the ensuing retaliatory missile responses by U.S.S.R. and U.S.A. could well have resulted in the big nuclear show down. Fini!

(b) About the same time as Chernobyl, a tremendous forest fire in Illinois created an earth shaking explosion. Would the sensors have "read" that as a call to respond by releasing interceptors? YES___ NO___

(bb) If YES, would intercepting over our own territory have "read" like an enemy missile strike and precipitated our missile release toward the enemy? YES___ NO___

Etc:Attractive to the sensors would be explosions of various land-based and air-borne materials and objects. Would the system be carefully turned off when satelites, shuttles, and rockets are launched? In case they might explode .... here, Guyana, China and so on. YES___ NO___

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P.2 BMDO-DPEIS 5-29-94 Hayes to Bailey

002

VARIATION: Does it concern BMDO that the proposed High Frequency Active Auroral Research Program (HAARP) could result in "total disruption of communications over a large portion of the earth."

and "act as a barrier to, or confusing factor for, hostile missiles or airplanes."...

and "become a serious threat to the earth's atmosphere"..?

YES___ NO___

003

FINALE: The environmental impact of BMDO starts with fabrication of the components. The most deleterious impact would follow a possible successful intercept of a nuclear missile over populated territory, thus spreading radiation over it to add to the direct impact of missiles not intercepted. Thank you - it is not a good scenario.

004

The best defense will come about when it is universally accepted that the most dangerous of mentally disturbed persons are those who design war wares, those who can bring them into production, sale, loan or use, and those paranoid ideologues who can influence otherwise normal persons into playing the mass murderous game we call war.

*Not to forget LOPPAC - the major operative for the Whoever/Whatever that dreamed up this whirly-gig we call the Universe. One cannot expect the WhoWhat to be concerned with the activities of mere sensate species: It has enough to do to choreograph universal dynamics that keep the spins spinning.

Encl: Map: Nuclear Occupied USA

cc National Security Advisor, Anthony Lake

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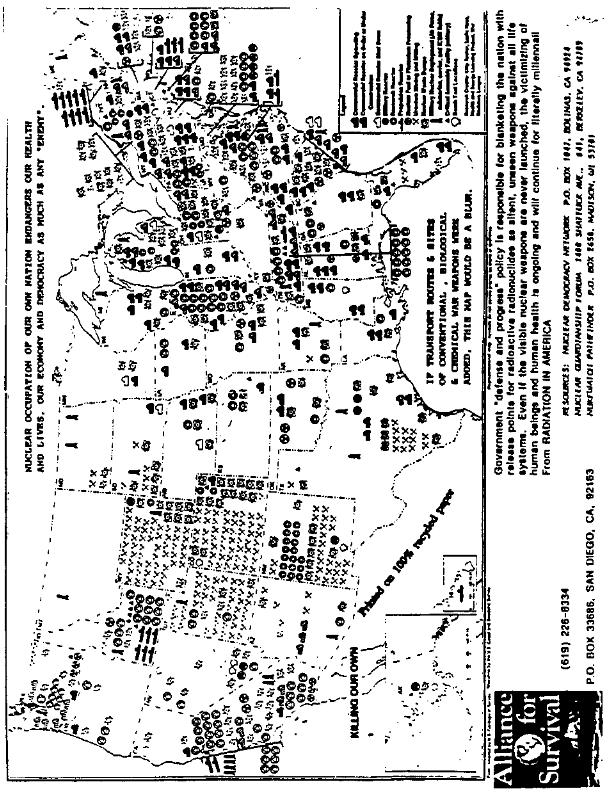


Document 0052

NUCLEAR AMERICA 1993

The actual physical occupation of our own country by nuclear power plants, nuclear weapons systems, and their subsequent waste products abrogates our human, civilian, and environmental rights, not in some hypothesized future, but now-- moment by moment.

The Nuclear Regulatory Commission (NRC) continues to make rulings that undermine public safety and favor the nuclear power industry over the public welfare. The nuclear industry has spent more than $200 billion on its failed nuclear dream--as much as the U.S. spent on the VietNam War and sending a man to the moon, combined. The industry promised nuclear energy would be safe, but instead gave us Three Mile Island; they promised nuclear waste would be no problem, but instead there is no solution.

The legacy of radioactive contamination due to nuclear weapons (and energy) production is only now coming under public scrutiny. For years, information was kept secret while health risks were vehemently denied by both contractors and the government agencies charged with protecting the public. Now we are beginning to understand the devastating environmental disaster upon us.

Our representatives in Washington continue the ongoing design and production of nuclear weapons which actually endorses the policy of an inevitable nuclear disaster. Accidental nuclear war could have been triggered by the numerous "nuclear attack warnings" that have been triggered by lightning flashes, pieces of old satellites falling to earth, meteors, aurora borealis, flocks of birds, and equipment failure. From 1979 to 1984, there were 20,784 "warning flash" signals of possible incoming missiles detected by sensors. Nuclear warning flash reports have not been available to the public since 1984, probably because the reports would have diminished the attractiveness of the Strategic Defense Initiative (SDI) or Star Wars which, if deployed, could have triggered more alarms.

Ten years after President Reagan delivered his "Star Wars" speech, thirty billion dollars has been spent on nothing more than blueprints. Yet, Star Wars is still alive and has taken a political and bureaucratic hold on Washington. Star Wars, in order to politically survive at a time of declining defense budgets with the end of the Cold War, has been revamped and is no longer the global orbiting space umbrella shield proposed by Reagan but now "a limited system of ground based missiles, augmented by orbiting elements to defend the nation from accidental or first strike nuclear attacks"--another dubious, yet expensive, taxpayer subsidized program.

While some lawmakers are calling for cuts in Star Wars, very few are calling for an end to the program. Instead, they are still caught in the "defense means jobs and jobs mean votes" trap, refusing to accept the fact that defense money produces far fewer jobs than money for civilian projects.

We call on the government to resume talks for a Comprehensive Test Ban Treaty, to stop all production of fissile materials (uranium, plutonium, tritium etc.) for warheads and power plants, to cut all spending for Star Wars and first-strike weapons systems like Trident, and to begin to find a way to manage the radioactive waste created over the last fifty years of the nuclear age.

NOTE:RE NULCEAR WASTE:HAZMAT WORLD JUNE 1992, P.58-ANAEROBIC BACTERIUM-GS15-DIGESTS URANIUM. DISCOVERED BY DR. DEREK LOVELY. US GEOLOGICAL SURVEY. "APPLIED & ENVIRONMENTAL MICROBIOLOGY, MARCH, 1992, P. 850-856. RECYCLED PAPER

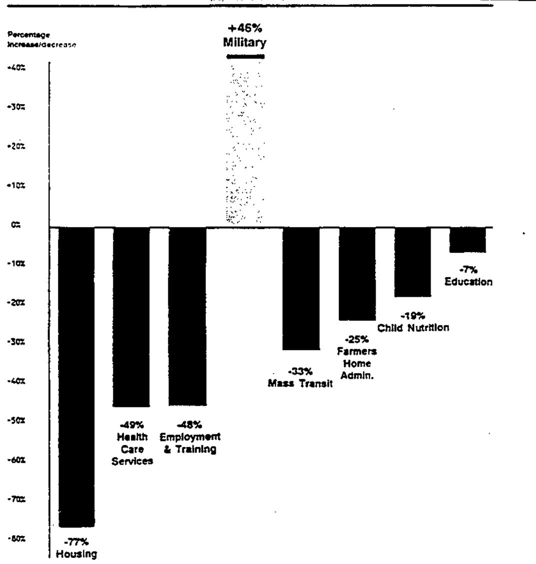
Document 0052

JWP Fact Sheet No. 3

Winners & Losers

Federal Spending From 1980-1990

(adjusted for inflation)



This chart measures how much spending has changed as a result of federal budget policies from 1980 to 1990.

Source: OMB (Office of Management and Budget) Watch 1731 Connecticut Ave NW Washington, DC 20009

JOBS WITH PEACE CAMPAIGN

National Office: 76 Summer Street, Boston, MA 02110 (617)338-5783

printed February 1990

Document 0053

May 28, 1994

TO: Major Tracy A. Bailey
Ballistic Missile Defense Organization
P.O. Box 4140
Gaithersburg, Maryland 20885-4140

FROM: Dollie Irwin, 420 N. Morongo Avenue, Banning, CA 92220
Carolyn Toenjes, 1863 Park Drive, Palm Springs, CA 92262

SUBJECT: United States of America Department of Defense, Ballistic Missile Defense Organization, BALLISTIC MISSILE DEFENSE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, APRIL, 1994

Thank you for this opportunity to review and comment/question the subject Draft PEIS. Please send the Final PEIS and related materials to both addresses above. As concerned citizens and taxpayers we ask that defense be compatible with a safe environment and all life and that our tax dollars be used in a wise and sane manner. Please accept the following comments:

001 1. Since you define this document as "programmatic" only, it is not necessary or possible to comment on impacts, to the environment and/or other related factors. Programmatic environmental assessments are nonsense.

002 2. This document should be entitled "An Assessment of Ballistic Missile Defense Policy." With no site specific or project specific information offered the environmental data is invalid and the document and its environmental consequences and mitigations are useless.

003 3. This document appears to test the waters, so to speak, to support, or not to support the decision to go forward with Star Wars, the Ballistic Missile Defense idea, which to date has been too costly, and, apparently, unworkable. Why not call it what it is?

004 4. We choose, as taxpayers, to not support the continuation of a National Missile Defense Program/the preferred action offered to continue research and development of NMD projects and elements, and to not support The System Acquisition Alternatives, with ballistic missile defense activities, under the NMD program.

005 5. We strongly feel that until the clean-up of previous defense related activities is completed in the United States that no more polluting, un-necessary defense activities be undertaken to further endanger life, health and the environment.

006 6. This money should be used for stronger and more effective intelligence work, research through NASA and to re-think SAC, the old Strategic Air Command with new technology, as a more effective and timely protection answer in the changing world of upstart threats to the U.S., friends and allies.

Dollie Irwin /s/ Carolyn Toenjes

Document 0054

HAROLD GELTMAN

4830 avenue Lacombe
Montréal, Québec
H 3 W 1 R 5

300-304 avenue St.Laurent ouest
Louiseville, Québec
J 5 V 1 K 3

tel:514-738-1833
May 30,1994

Reference: Harold Geltman 5 page letter to the BMDO, May 18, 1994 confirmed by 1-800-636-2636 preliminary verbal comments requesting executive summary and Draft Programmatic Environmental Impact Statement (DPEIS). Received May 25-27,1994 Montréal--Louiseville.

Have as yet to receive written acknowledgement of the 5 page letter-brief of May 18,1994.

Transmission of May 30,1994:
DPEIS
Major Tracy Bailey
Ballistic Missile Defense Organization / AQT
7100 Defense Pentagon
Washington, D.C.
20301--7100
tel: 1-800-636-2636

13 pages
5/30/94
dep: 16:49
arr:

COMPUTER INSTRUCTIONS STAFF (N.B.)

001 1) correct all grammatical and typing errors

2) Verify computer programming upon specific "word and phrasing errors"; for example, in May 18,1994 5 page Harold Geltman letter: page 3, "Mis-reading of situational intentions DEMOCRACIES ARE ALWAYS MORE VULNERABLE TO ABUSE THAN DICTATORSHIPS BUT DICTATORSHIPS ARE NOT SO EASILY ACCESSIBLE TO CORRECTING THE ABUSES AS DICTATORSHIPS." LAST WORD SHOULD READ "DEMOCRACIES" but the example serves to illustrate the difficulties and perils of automatic computerized correction when both words " DICTATORSHIPS and DEMOCRACIES could be used interchangeably in many situational examples, depending upon which side one is leaning on in the arguments.

3) Make sure that in the design of word-phrase correction there is room for such nuances and interpretive readings in many different languages and translations and I am asking STAFF to anticipate these kinds of errors in working with HAROLD GELTMAN, for many different kinds of reasons.

4) The hockey and other sports analogies works well; what did he originally mean; what did he allow it to mean; what did it end up meaning; what was his corrected meaning; how many different meanings are there now in existence; which meaning is closest to the truth; as it was, as it is and/or as it will be. This is another good example of the shades of meaning and "PUCK SENSE" means knowing what to do with the puck when it's rolling your way and when it isn't rolling your way.
Intentional and unintentional draw plays and knowing how to recover one's own fumble and an opponent's fumble are a few of many other such comparative examples that lend themselves to bettering understanding.

5) Verify the degree of difference, dissent, hostility and hatred in all other countries of the world when communications are transmitted in ENGLISH other than the home country native language: domestically internationally and specifically with the United States of America.

Document 0054

6) This is a second test of COMMUNICATIONS CHANNELS BETWEEN HAROLD GELTMAN AND PART OF THE AMERICAN GOVERNMENT: Anticipate and be prepared to intercept the individuals and groups that simply do not want Harold Geltman to have any kind of effective verbal-oral and/or written communication with the people and government of the United States of America, either on my own and/or through their own intermediary control.
Do NOT underestimate this growing problem which has "iceberg--like" dimensions. REPEAT DO NOT UNDERESTIMATE THIS PROBLEM.

7) Re-program COMPUTER INSTRUCTIONS-1-17 of May 18,1994 letter-brief to apply toward May 30,1994 letter-brief.

8) Anticipate and intercept those that try to service this letter as if though they give the impression that they have a claim of authorship. Harold Geltman is solely responsible for the writing of this brief-letter.

APPENDIX A & B : Abbreviations & Acronyms Glossary

Anticipate and intercept any possible built-in time frame designed to limit the manoeuvrability of the ideas put forward in the name of Harold Geltman.

Allow for future use of foreign language terms that might have a rising environmental influence in other military venues.

Do our terms, languages and glossaries have the same meaning in other languages and countries and how do we know that?

Be careful that our acronyms don't have an embarrassing definition in some other language.

002 APPENDIX C Ballistic Missile Defense Mailing List

If this is the fact, why are U.S. Senator, the Honourable Charles Jonas and U.S. House of Representatives Karan Shephard the only two (federal) elected officials?

How was "EXPRESSED INTEREST" determined?

I thank those that have expressed such an interest and I am telling you that 10-20 years from now, your memory of this interest shall appear as one of the turning points of America and the WORLD.

When environmental military defense fails in peacetime, we see what can happen in war-time. When environmental military defense fails in war-time, there is often no second chance to restablish environmental peace, no matter how strong the military might.

I wish you well in your continuing efforts to make a BETTER WORLD where there seems to be so little will to do so and I encourage you in your courage to believe that you can make a good difference.

Document 0054

I want to know what kind of internal debate there is on this issue and what kind of open public debate ?

The people have a RIGHT TO TELL THEIR LEADERS WHAT THEY WANT AND WHAT THEY DON'T WANT.

THUNDERAND LIGHTNING WARNINGS ARE DESIGNED TO WARN THE PEOPLE OF THEIR WRONG SENSE OF CHOICES IN RAISING THEIR CHILDREN.

BABIES ARE NOT MISSILES.

More on this in the future.

Will want to read the results of "Gelling of ClF_5 is currently being investigated". page F-9

APPENDIX G REGULATORY INFORMATION

THANK YOU, for including this.

a brief paragraph on the leadership conflicts of over-lapping and conflicting legislative acts and jurisdictions on a municipal, regional, State and national level of 190 countries and a World level: demonstrate domestic and foreign conflicts, on an anticipatory illustrative basis.

COMPUTER INSTRUCTIONS continued from page 1

9 expanding from G-42...

Anticipate Harold Geltman's leadership requirements:
How vulnerable are Harold Geltman's ideational, voice, image, photo, physical-body and presence characteristics to the following intrusions:
a) conceptual sinkholes
b) negative/positive conversational airpockets
c) discursive quicksand debating tactics
d) planted under-current questions

APPENDIX H ORBITAL DEBRIS

Interesting.

003 APPENDIX I HAZARDOUS MATERIALS AND WASTE

Include 3rd column: degree, quality and criteria of environmental response.

004 APPENDIX J HEALTH AND SAFETY HAZARDS

EXTRA COLUMN: ENVIRONMENTAL EDUCATIONAL HEALTH PREVENTIVE STEPS

Document 0054

APPENDIX K SOCIOECONOMIC IMPACT ANALYSIS METHODS AND APPROACH

GOOD AND THANK YOU VERY MUCH

Figure K-1 Macro Socioeconomic Systems Approach

Figure K-2 Program Impact Assessment Model

005 Can we prepare these charts for domestic and country-wide basis where American friends and allies reside?

I would like to see side by side the comparative flows in domestic USA and domestic other countries where American interests are at stake and then to depict these items for Harold Geltman preparatory thinking:

a) K.4.1.1 battle management /Command, Control and Communications

"when technology transfer is successful , new and different products or processes become available to meet or generate market demand (Schacht 1993) page k-18

We get ourselves into so many "knotty difficulties" because we underestimate the value and importance of our failures upon other constituencies that make added interpretive judgments that are beyond our range of intervention.

Understanding the past, present and future flow of peoples ideas and products around the world shall have more and more of deliberate, consequential and unanticipated multiple effects than we will know what to do with and more than our models can handle. Thus leaving room for more and more indecisive "fly by the pants" decision-making, which will attract un-systems-like behavioural leaderships.

Intellectualism around the world and in America simply doesn't have a good record of performance when it finds its problems being packaged in un-intellectual shapes.

If the environmental movement and the military cannot bring forth a negotiated compromise on this issue, which two other polarities do you expect to do so?

Document 0054

PLANETARY WARNING

The atrophic influences upon PLANET EARTH arise from the convergent and cumulative forces of GREED, CORRUPTION, CRIME, POVERTY and INCOMPETENCE which when merged can form a formidable siege of emotion of self-hatred built-in to the everyday lives of people.

There is rising on planet earth a kind of enemy that may not be able to be halted by any form of military intervention.

The onus upon good leadership is becoming more and more tiring for reasons that fewer and fewer people seem to care about or want to understand.

If people lose their sense of making important priority decisions, they will lose their own sense of balance on earth.

WE ARE FAILING TO TEACH CHILDREN A PROPER SENSE OF HOW TO ARRIVE AND ACHIEVE QUALITATIVE AND QUANTIATIVE DECISIONS OF JUDGMENTAL PRIORITIES.

It is this which is lowering the degree of adult care around the world.

There is only so much time available to make these corrections and changes in navigatory decisions.

COMPUTER INSTRUCTIONS (continued from page 7)

10) In case of doubt, verify received "edition" of letter-brief with original for enquiries an "corrections" and other apparent alterations to the script.

11) Anticipate and provide for further testing of communications between Harold Geltman and the various parts of the American Government and the American people on a fixed and/or mobile basis, in 1994-1995.

12) A third communications test should be anticipated and planned with Harold Geltman positioned in and/or around the LAC SACACOMIE district above St. Alexis Des Monts with the approximate co-ordinates of: 46°30' North and 73°15' west. Here are some of the particulars that require verification:

a) relationship of 46°30' North and 73°15' west with
46°30' south and 73°15' west
46°30' south and 73°15' east
46°30' north and 73°15' east

in 1776, 1867, 1872 (year in which St. Bernard Fish & Game Club was founded on Lac Sacacomie) and 1994-1995.

b) possible link of name Lac Sacacomie and the attached photo-caricature from L'Echo de Saint Justin, July 10,1942 page 6 depicting pedlar with "sack".

c) possible attempt of making name mean "SAC A Communist"

d) possible link of Lac Sacacomie and SAC: Strategic Air Command. Find the built-in time frames in b) & d).

e) is there a link with: p.k-16 US Army Kwajalein-Atoll (USAKA)

f) there is a security territorial problem in this area of St. Alexis des Monts with some kind of a built-in time frame that involves the United States and I want to find the roots of the problem. Verify possible link with American military installations in the state of Maine.

Document 0054

13) Verify the transfer of mailing address from Gaithersburg Maryland to Washington, D.C. and the political parallels of the transfer.

14) Anticipate the problems arising from the relationship perceived between Harold Geltman and the 7100 Defense Pentagon address with the various connotations:

a) 1971 for and against Harold Geltman
b) Pent-SAG on and/or off scripts
c) "the we've been waiting for you" attitudes: pro &/or con

15) Verify the political constituencies of Senator Jones and Representative Shepherd for specific military and/or civilian installations that might have an important link to this issue of environmentalism and the military and find the roots of the problem/problems that I am not familiar with but which is possibly causing concern.

16) What else should I be brought up to date on with respect to pre and post DPEIS ?

006 17) Will the Congressional elections in 1994 impinge upon the course of this issue and if so in which political constituencies?

007 18) Are there any specific classified new technologies in "the pipeline" that might put the findings of the DPEIS into doubt or give cause for another kind of review?

008 19) Has the United States ever been asked to prepare a DPEIS by some foreign country concerning American military installations abroad? How do you plan to handle such a potential request?

20) Are there any present limitations to the DPEIS that fail to give truth to any particular part of the larger issues?

page 10 attached caricature...letter brief continues on page 11.

21) 2nd voice communication called into 1-800-638-2636 from pay phone in region 1-819-228- on this afternoon of May 30 1994

22) if I do not receive written confirmations of my May 18,1994 5 page letter and May 30 1994 13 page letter-brief, I shall declare this level of communication unsatisfactory.

23) anticipate and intercept attempts to have Harold Geltman removed in some kind of forged medical sickness as a means of trying to negate his American influence. This causes serious inconveniences to some of his opponents.

24) this 13 page letter-brief is self-protected against theft, loss, forgery, blackmail, substitute signatures, electronic errors in reproduction, and any other kind of problems that might arise in the transmission and delivery of the letter-brief.

Document 0054

25) who might not be able to read this brief unless you the reader attain authorization to deliver its contents, unedited, directly to the designated reader, other than yourself?

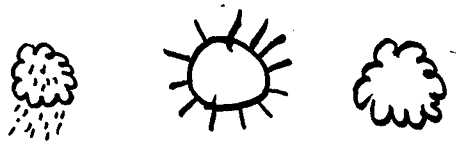
26) the fight to preserve the future of the english language is just as important, if not more important, as the fight to preserve the use of the french language: anticipate problems of delivery and resolve these problems because the brief was written entirely in english in a french speaking area.

009 27) I would like to receive specific biographical and reading materials & statements from elected politicians that have made comments upon the DPEIS. (please also include verbal comments on telephone call of may 30,1994)

28) verify that no errors are made in spelling of the HAROLD GELTMAN name and intercept attempts from those that might order the name to be deliberately mis-spelt for alleged security reasons: find the roots of this problem.

29) I thank Major Tracy Bailey, his staff and all other personnel that have contributed towards the preparation of this assignment and in anticipation of future work responsibilities I thank those that shall have volunteered towards MAKING THIS A BETTER WORLD by demonstrating how MAKING A BETTER AMERICA MAKES A BETTER WORLD.

30) in the event pay phone number might be changed in the future, phone call was made from across the street of the 300-304 avenue St. Laurent ouest address on may 30, 1994, in Louiseville Québec.



Harold Geltman

Document 0057

STATE OF ILLINOIS

OFFICE OF THE GOVERNOR

SPRINGFIELD 62706

JIM EDGAR
GOVERNOR

May 24, 1994

Michael T. Toole
Colonel, USA
Director, Test and Evaluation
Department of Defense
Ballistic Missile Defense Organization
7100 Defense Pentagon
Washington D.C. 20301-7100

Dear Colonel Toole:

SUBJECT: Project Report: Ballistic Missile Defense Draft Programmatic Environmental Impact Statement. Submitted by the United States Department of Defense, Ballistic Missile Defense Organization.

001 *By Federal Executive Order, The Illinois State Clearinghouse/Office of the Governor, has reviewed the reference subject pursuant to the National Environmental Policy Act of 1969. State agencies which are authorized to develop and enforce environmental standards have been given the opportunity to comment on this subject. At this time, no comments have been received. However, the State of Illinois reserves the right to make additional recommendations at a later date if necessary.*

The Illinois State Clearinghouse requests that any future correspondence include the above referenced SAI#.

Should you require additional information, please contact me at (217)782-1671 and I will place you in touch with appropriate state officials.

Sincerely,

Stephen Klokkenga

Stephen Klokkenga
Coordinator/SPOC
Office of the IL Governor

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Document 0058

THE LIBRARY OF CONGRESS
WASHINGTON, D.C. 20540-4200

EXCHANGE AND GIFT DIVISION

May 5, 1994
Our reference: AG

Michael T. Toole
DEPARTMENT OF DEFENSE
BALLISTIC MISSILE DEFENSE ORGANIZATION
7100 Defense Pentagon
Washington, DC 30201-7100

Dear Mr. Toole:

001 It is my pleasure to acknowledge, with many thanks, receipt of the material mentioned below. We deeply appreciate your kindness in sending this material to the Library of Congress.

Sincerely,

Donald P. Panzera
Chief

The material received:
" DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (DPEIS) for the Ballistic Missile Defense Program

Document 0060

The George Washington University
WASHINGTON DC

OFFICE OF VICE PRESIDENT AND TREASURER

June 7, 1994

Major Tracey Bailey
Ballistic Missile Defense Organization
P.O. Box 4140
Gaithersburg, MD 20885-4140

Dear Major Bailey:

001 It is my pleasure to acknowledge on behalf of the Board of Trustees of The George Washington University your contribution of one copy of Ballistic Missile Defense Draft Programmatic Environmental Impact Statement to the Gelman Library and to express the appreciation of the University for your interest.

Sincerely,

Gearldean L. Wynkoop
Assistant Treasurer

2121 I STREET, N.W. • SUITE 701 • WASHINGTON, DC 20052 • (202) 994-6600 • FAX (202) 994-9304

Document 0061

FM208

06-16-94

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
116 WEST JONES STREET
RALEIGH NORTH CAROLINA 27603-8003

INTERGOVERNMENTAL REVIEW COMMENTS

MAILED TO:
DEPT. OF DEFENSE
MAJOR T. BAILEY
BMDO/AQT, 7100 DEF. PENTAGON
WASHINGTON, D.C. 20301-7100

FROM:
MRS. CHRYS BAGGETT
DIRECTOR
N C STATE CLEARINGHOUSE

PROJECT DESCRIPTION:

DRAFT PROGRAMMATIC EIS FOR THE BALLISTIC MISSILE DEFENSE PROGRAM - CONTINUE TO CONDUCT A TECHNOLOGY READINESS PROGRAM FOR NATIONAL MISSILE DEFENSE

SAI NO 94E00000770 PROGRAM TITLE - DRAFT PROGRAMMATIC EIS

THE ABOVE PROJECT HAS BEEN SUBMITTED TO THE NORTH CAROLINA INTERGOVERNMENTAL REVIEW PROCESS. AS A RESULT OF THE REVIEW THE FOLLOWING IS SUBMITTED: ( ) NO COMMENTS WERE RECEIVED

(X) COMMENTS ATTACHED

SHOULD YOU HAVE ANY QUESTIONS, PLEASE CALL THIS OFFICE (919) 733-7232.

Document 0061

State of North Carolina
Department of Environment, Health and Natural Resources
Legislative Affairs

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
Henry Lancaster, Director

DEHNR

TO: Chrys Baggett

FROM: Bill Flournoy BF.

SUBJECT: Draft Programmatic EIS, Ballistic Missile Defense Program (SCH # 94-0770)

DATE: June 15, 1994

The N.C. Dept. of Environment, Health, and Natural Resources has reviewed the draft programmatic EIS (DPEIS) for the Ballistic Missile Defense Program and offers the following and attached comments. The department anticipates the opportunity to review more specific NEPA documents as this program evolves and becomes more site-specific.

The DPEIS reviews the Environmental Setting at a national scale, while the Environmental Consequences are reviewed at a generalized site impact scale compatible with the current phase of activity. While this is a valid approach, it is not known to what extent this environmental setting will be used as a frame of reference for future NEPA documents. Thus, it is important for the programmatic EIS to acknowledge the most important baseline characteristics that should be considered in both this and future decisions. The following comments address some of those characteristics.

001 Air Quality. Among the issues of concern discussed at section 3.1.2 there was no mention of Non Degradation. Areas are designated as Class I where they are considered to have or should have a high degree of air quality. The classification provides regulation to protect against degradation from point sources of pollutants. Even though future National Missile Defense (NMD) sites will not have continuous emissions, non degradation may still be an issue of concern related to sting proximity.

002 Noise. Existing noise assessment methodology and the accepted Federal land use compatibility processes are not sufficient to either characterize the environment or protect the public. This department is on record supporting Ldn as an appropriate matric, but the need is also recognized for the resulting averages to be supplemented with information on single event levels (SEL) of noise and frequency of event data. Most of the rural area along this state's coastal plain fringe already have an urban noise character as a result of low-level aircraft flights. Thus, it cannot be

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002 assumed that such rural areas automatically have rural ambient noise levels. Nor, should it be assumed that because the area has urban ambient noise levels that an additional noise source would not be significant. Existing Federal land use compatibility processes do not adequately address rural areas, natural resource based parklands or refuges, and wilderness areas to name only several low noise environments where the difference between ambient and SEL noise is significant. These deficiencies should be recognized as issues of concern related to sitting proximity.

003 Surface Water. Areas may be designated as High Quality Waters and protected from future degradation. As with the previous comments on air quality, non degradation of such surface waters is an important issue of concern related to sitting proximity and it should be addressed appropriately.

004 Soils. Much of this state's coastal plain soils are high in organic matter and vulnerable to fire. This high fire hazard is a characteristic of significant potential impact that deserves to be discussed as an issue of concern.

005 A topic that was unmentioned in the DPEIS was Special Use Airspace (SUA) as designated by the Federal Aviation Administration. As the nations airspace becomes more congested, facility sitting and airspace management issues become more critical. On the assumption that deployment of a future NMD system, and perhaps some earlier activities, may require new SUA designation or amendment of existing designations then it will be appropriate for this topic to be introduced.

The attached comments are from divisions of this department. Any questions may be directed to me or the individual commentor. The opportunity to review the DPEIS is appreciated.

Attachment.

The DPEIS

State of North Carolina
Department of Environment, Health and Natural Resources
Division of Coastal Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
Roger N. Schecter, Director

DEHNR

MEMORANDUM

TO: Melba McGee, Division of Policy and Development

FROM: Steve Benton, Division of Coastal Management

DATE: June 10, 1994

REFERENCE: SCH94-0770 Draft Programmatic EIS for the Ballistic Missile Defense Program

The Division of Coastal Management has undertaken a preliminary review of the referenced document. The proposed Ballistic Missile Defense Program appears broad in both scope and geographic area. According to the document environmental reviews for individual components of the Program will be submitted as they are developed.

Any activity which will occur in or could affect land or water use or natural resources of the coastal zone of North Carolina will require a consistency determination pursuant to Section 307 of the Coastal Zone Management Act, as amended, and 15 CFR 930 Subpart C, Consistency for Federal Activities.

P.O. Box 27687, Raleigh, North Carolina 27611-7687 Telephone 919-733-2293 FAX 919-733-1495

DIVISION OF ENVIRONMENTAL MANAGEMENT

AIR QUALITY SECTION

May 9, 1994

MEMORANDUM

To: Melba McGee
Environmental Assessment Section

From: Alan Klimek, Chief LSB for

Subject: Project No. 94-0770
Ballistic Missile Defense Draft Programmatic Environmental Impact Statement

The environmental impact statement has been reviewed by the Air Quality Section. The Department of Defense Ballistic Missile Defense Organization has proposed to develop systems and capabilities to protect the Unites States against accidental, unauthorized, and limited ballistic missile strikes and to defend U.S. troops, allies, friends, and areas of vital interest to the United States against ballistic missiles launched against them.

Activities pertaining to this project would involve the handling of substances listed as hazardous air pollutants (HAPs) and the generation of exhaust clouds from rocket and ground-based interceptor launches and static testing. Emissions would generally be minimal in magnitude and brief in duration. All emissions are expected to be below the limits specified in the National Ambient Air Quality Standards (NAAQS) and the National Emissions Standards for HAPs (NESHAPS).

If construction resulting from this project will take place in North Carolina, an air quality permit may be required. Otherwise, the Air Quality Section has no comments concerning this project. Should you require further information in this regard, please advise.

cc: Lesley Biller
dodbmdo.eis

North Carolina Wildlife Resources Commission
512 N. Salisbury Street, Raleigh, North Carolina 27611, 919-733-3391
Charles R. Fullwood, Executive Director

MEMORANDUM

TO: Melba McGee, Office of Policy Development
Dept. of Environment, Health, & Natural Resources

FROM: David Yow, District 9 Coordinator
Habitat Conservation Program
David Yow for

DATE: June 1, 1994

SUBJECT: Comments on the U. S. Department of Defense (DOD) Draft Programmatic Environmental Impact Statement, Ballistic Missile Defense [illegible], Policy Development Project No. 94-0770.

[illegible] from Col. Michael T. Toole of the DOD for our comments regarding impacts on fish and wildlife resources resulting from the alternatives proposed in the environmental document. The N. C. Wildlife Resources Commission (NCWRC) has reviewed the subject document, and our comments are provided in accordance with provisions of the National Environmental Policy Act (42 U.S.C. 4332(2)(c)) and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d).

Of the four alternatives evaluated in the environmental document, the preferred alternative of continuing present program operations apparently involves the least potential impact on surface waters, wetlands, and biological resources. The NCWRC agrees that all wetland fill should be carried out under appropriate permits administered by the regulatory program of the U. S. Army Corps of Engineers. Such site-specific permitting situations should be addressed by the DOD as design information on new, expanded, or decommissioned facilities becomes available. In particular, opportunities to avoid or minimize impacts on high quality habitats, wetland or upland, should be considered when siting facilities.

The NCWRC concurs with the findings of this environmental document, and offers no further modifying comment.

Document 0061

Memo Page 2 June 1, 1994

Thank you for the opportunity to provide input in the early planning stages for this project. If I can further assist your office, please contact me at (704) 274-3646.

cc: Randy Wilson, Nongame/Endangered Species Program Mgr.
L. K. Gantt, U. S. Fish and Wildlife Service, Raleigh

Document 0063

STATE OF FLORIDA

Office of the Governor

THE CAPITOL
TALLAHASSEE, FLORIDA 32399-0001

LAWTON CHILES
GOVERNOR

June 21, 1994

Major Tracy Bailey
BMDO/AQT
Department of Defense
7100 Defense Pentagon
Washington, D.C. 20301-7100

RE: Draft Programmatic Environmental Impact Statement (DPEIS) for the Ballistic Missile Defense Program

SAI: FL9405120344E

Dear Major Bailey:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372 and in accordance with the provisions of the National Environmental Policy Act (NEPA), has completed its review of the above referenced document.

This review was coordinated with the Departments of Agriculture and Consumer Services, Community Affairs, Environmental Protection, State, and Transportation, the Game and Fresh Water Fish Commission, Marine Fisheries Commission and the Governor's Environmental Policy Unit. The proposal was also reviewed by the Northwest Florida, St. Johns River, South Florida, Southwest Florida and the Suwannee River Water Management Districts. Comments received from the Department of Environmental Protection and the Department of State are summarized below.

001 The Department of Environmental Protection states that the document presents the purpose and need for developing a defense program and associated activities, however, it is not site specific so its usefulness in identifying potential impacts to state resources is limited. The expansion of this program in Florida will need to be evaluated based on the potential impacts to specific locations. The department requests that any subsequent documents pertaining to the Ballistic Missile Defense Program be forwarded to the state for review.

002 The Department of State indicates that the nature and location of project activities could have an adverse effect on historic properties listed, or eligible for listing, in the National Register. The department recommended that the project be conditioned upon the implementation of measures set forth in the DPEIS in regard to cultural resources and the following requirements:

1. Notification of the department that the federal agency will identify, evaluate and appropriately design project activities to avoid or minimize adverse impacts to historic properties listed or eligible for listing in the National Register of Historic Places.

Document 0063

Major Tracy Bailey
Page Two

002
2. Consult with the department in the identification and evaluation of archaeological sites or pre-1945 structures which may be impacted by the project.
3. Consult with the department on measures to avoid or minimize impacts to project activities adversely affecting properties listed, or eligible for listing, in the National Register or otherwise of historical or archaeological value. If project plans cannot be modified, then measures to minimize or mitigate impacts may be warranted.

003 It is clear that expansion of the program as described in the Preferred Alternatives could affect various aspects of the human and natural environment in Florida. Any future program documents proposing expansion at Florida sites should include a determination of the consistency of the proposed activities with the Florida Coastal Management Program, pursuant to the requirements of 15 CFR 930, Subpart C, and the Coastal Zone Management Act, 16 U.S.C. sections 1451-1464.

The proposed action will be in accord with state plans, programs and policies when consideration is given to the comments and recommendations of our reviewing agencies.

This letter reflects your agency's compliance with Presidential Executive Order 12372 and the National Environmental Policy Act.

Sincerely,

Estus Whitfield

Estus D. Whitfield
Policy Coordinator
Environmental Policy/Community and
Economic Development Unit

EDW/mt

Enclosures

cc: Department of Environmental Protection
Department of State

Document 0063

FLORIDA

Department of Environmental Protection

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

13 June 1994

JUN 14 1994

IGA

Suzanne Traub-Metlay
State Clearinghouse
Office of Planning and Budgeting
Executive Office of the Governor
the Capitol
Tallahassee, Florida 32399-0001

RE: Ballistic Missile Defense Draft Programmatic Environmental Impact Statement
SAI: FL9405120344C

Dear Ms. Traub-Metlay:

The Department of Environmental Protection has reviewed the Draft Programmatic Environmental Impact Statement (EIS) prepared for the Ballistic Missile Defense Organization. The document presents the purpose and need for developing a ballistic missile defense program and the activities associated with this development that may result in environmental impacts. While this report is adequate in conveying all the various types of environmental impacts that these activities will have, it is not site specific so its usefulness in identifying potential impacts to state resources is limited. For example, there are any number of variables that limit where the static firing of rocket motors can be tested, most of which are not environmental constraints. Therefore, the expansion of the ballistic missile defense program in Florida will need to be evaluated based upon the potential impacts to specific locations.

We request that any subsequent documents pertaining to the Ballistic Missile Defense Program be forwarded to the state clearinghouse for review. If there are any further questions, please call me at (904)488-0784.

Sincerely,

Susan Goggin

Susan Goggin
Environmental Specialist
Office of Intergovernmental Programs

FV:seg
cc: Ed Wood, State Lands

"Protect, Conserve and Manage Florida's Environment and Natural Resources"

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Document 0063

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480 — Telecopier Number (FAX) (904) 488-3353

June 1, 1994

Ms. Janice L. Hatter, Director
State Clearinghouse
Executive Office of the Governor
Room 1603, The Capitol
Tallahassee, Florida 32399-0001

In Reply Refer To:
Frank J. Keel
Historic Sites
Specialist
(904) 487-2333
Project File No. 941589

RE: Cultural Resource Assessment Request
SAI# FL9405120344C
Ballistic Missile Defense Draft Programmatic Environmental Impact Statement

Dear Ms. Hatter:

In accordance with the provisions of Florida's Coastal Zone Management Act and Chapter 267, Florida Statutes, as well as the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places, or otherwise of historical or architectural value.

The nature and/or location of the activities included in the Ballistic Missile Defense Program is such that they could have an adverse effect on historic properties listed, or eligible for listing, in the National Register. Therefore, it is the recommendation of this agency that this project be conditioned upon the implementation of measures set forth in the DPEIS in regards to cultural resources and the following:

1) To notify this agency upon receipt of project approval that the Federal Agency intends to comply with efforts to identify, evaluate and appropriately design project activities to avoid or minimize adverse project impacts to any historic properties listed, or which satisfy the criteria of eligibility for listing (36 CFR 60.4), in the National Register of Historic Places. Such notification will include the name and telephone number of the individual designated by the applicant to fulfill these conditions.

Archaeological Research — Florida Folklife Programs — Historic Preservation — Museum of Florida History

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2) To consult with this agency in the identification and evaluation of any archaeological sites or pre-1945 structures which may be impacted by scheduled project activities, or properties located adjacent to the activity areas. Final project reports with recommendations and conclusions will be forwarded to this agency for review.

3) To consult with this agency concerning measures to avoid or minimize impacts of any project activities adversely affecting properties listed, or eligible for listing, in the National Register, or otherwise of historical or archaeological value. In cases where project activities adversely impact historic properties, avoidance by way of project modifications is the preferred alternative. If project plans cannot be modified, then measures to minimize or mitigate impacts may be warranted.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Suzanne P. Walker
for George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Kfk
xc: Col. Michael T. Toole, Director, Test and Evaluation

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STATE CLEARINGHOUSE
State of Ohio - Office of Budget and Management
30 EAST BROAD STREET • 34TH FLOOR • COLUMBUS, OHIO 43266-0411 • (614) 466-0697 / 0698

May 27, 1994

U.S. DEPT OF DEFENSE
BMDO/AQT DEFENSE PENTAGON
WASHINTON, DC 20301-7100

Attention: MAJOR TRACY BAILEY PHONE: 800-636-2636

RE: STATE INTERGOVERNMENTAL REVIEW
ENVIRONMENTAL ASSESSMENT/IMPACT STATEMENT COMPLETION LETTER

State Application Identification (SAI) Number: OH940422-Y407-36.421

Project Description: BALLISTIC MISSILE DEFENSE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, NATIONWIDE IMPACT, APRIL 1994, BALLISTIC MISSILE DEFENSE ORGANIZATION

Dear Applicant:

The State Clearinghouse has reviewed the Environmental Assessment/Impact Statement for the above identified project that is covered by the National Environmental Act of 1969, and any amendments; the Intergovernmental Review Process (Presidential Executive Order 12372); Gubernatorial Executive Order authorized under Ohio Revised Code, Section 107.18(A); and/or other pertinent regulations and guidelines.

This document has been simultaneously reviewed by interested state agencies, with a notice to the impacted area clearinghouse(s). Our office may have attached comments for your consideration and/or response.

001 You should be advised that some of the reviewing state agencies may respond directly to you without submitting their comments through the Single Point Of Contact. We encourage our reviewing agencies to keep in direct contact with issuing agencies on all environmental assessment/impact statement reviews. Therefore, consider their directly generated comments as valid responses.

It is recommended that contact be made with all commenting agencies. Addresses and phone numbers are available on individual Transmittal Forms and /or contained in a letter received by our agency. The comments which have been generated should become part of the proposal and responded to before a final decision is made regarding this environmental assessment/impact statement.

Should this be a draft proposal, please provide our office with fourteen (14) copies of the final product.

Sincerely,

Larry W. Weaver, Federal Funds Coordinator
Office of Budget and Management

OBM 6000

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OFFICE OF BUDGET AND MANAGEMENT
STATE CLEARINGHOUSE TRANSMITTAL
30 E. Broad St., 34th Floor
Columbus, Ohio, 43266-0411
Phone (614) 466-0697 / 0698

SAI NUMBER: OH940422-Y407-36.421
RESPONSE ON 60 DAY REVIEW SHOULD BE RETURNED 15 DAYS PRIOR TO CLEARANCE DATE OF: **May 27, 1994.** FOR FULL APPLICATION CALL BY : call DoD.

APPLICANT: U.S. DEPT OF DEFENSE
ADDRESS: BMDO/AQT DEFENSE PENTAGON
WASHINTON, DC, 20301-7100
ATTENTION: MAJOR TRACY BAILEY PHONE: 800-636-2636
PROPOSED FEDERAL FUNDING: $0
PROPOSED TOTAL FUNDING: $0
TITLE: DEFENSE - ENVIRONMENTAL IMPACT ASSESSMENT
PROJECT DESCRIPTION: BALLISTIC MISSILE DEFENSE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, NATIONWIDE IMPACT, APRIL 1994, BALLISTIC MISSILE DEFENSE ORGANIZATION

REVIEWING AGENCY:
AGRICULTURE
NATURAL RESOURCES
HEALTH
TRANSPORTATION
ENVIRONMENTAL PROTECTION AGY
GOVERNOR — 77 So High - legal div
HISTORICAL SOCIETY

RECEIVED
MAY 31 1994
State Clearinghouse
Budget & Management

STATE WIDE CLEARINGHOUSES

ASHLAND	ASHTABULA	AUGLAIZE	BEL-O-MAR	B-H-J	BH-HVRDD	CLARK
COLUMBIANA	CLINTON	CRAWFORD	EDATA	ERIE	FAIRFIELD	FAYETTE
HANCOCK	HARDIN	HURON	KNOX	KYOVA	LICKING	LIMA-ALLEN
L-U-C	MADISON	MARION	MAUMEE	MERCER	MIAMI CC	MIAMI VALLEY
MORPC	MORROW	NOACA	NEFCO	O-K-I	OMEGA	OVRDC
PICKAWAY	PORTAGE	PUTNAM	RICHLAND	SENECA	SHELBY	STARK
TMACOG	VAN WERT	WYANDOT				

Reviewing agency must complete this section.
COMMENTS - attach another sheet. Comments cited in this Section must include (1) Identification of reviewing agency's statute or specific plan or program related to this proposal, (2) Description of impact of this proposal on identified plan or program, (3) Reviewer's recommended changes for or additions to the proposal. Please type all comments and include SAI number on your comment sheet.

REVIEWING AGENCY POSITION ON PROJECT (Mark one only)

- ☐ No comment.
- ☐ Clearance of the project should be granted.
- ☒ Clearance of the project should not be delayed, but applicant should answer the reviewer's questions or concerns. See enclosed comments.
- ☐ Clearance of the project should only be granted on the condition that the applicant use the recommendations in the enclosed comments. (Executive or Deputy Director Signature Needed.)
- ☐ Clearance of the project should be delayed until the applicant has satisfactorily addressed the concerns stated in the enclosed comments. (Executive or Deputy Director Signature Needed.)

PLEASE TYPE THE FOLLOWING INFORMATION.

Reviewer's Name: Todd Tucky
Agency Name: OHIO HISTORIC PRESERVATION OFFICE — Div
Street Address: 1982 VELMA AVE. — City — State
COLUMBUS, OH 43211 — Zip Code
Phone: 614-297-2470
Executive or Deputy Signature: Martha J. Raymond
MAY 3? 1994

OBM 6005 (Rev 8/87)

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Ohio Historic Preservation Office

Ohio Historical Center
1982 Velma Avenue
Columbus, Ohio 43211-2497
614/297-2470
Fax:297-2411

SAI # Y407-36.421

Location: STATEWIDE

Reviewer: TODD TUCKY

OHIO HISTORICAL SOCIETY
SINCE 1885

The Ohio Historic Preservation Office (OHPO) is a division of the Ohio Historical Society. The Ohio Historic Preservation Officer and his staff are responsible for reviewing the effects of federally assisted projects on cultural resources, i.e. properties of archaeological, historic or architectural significance, in accordance with the National Historic Preservation Act of 1966 and the 1980 Amendments, and the National Environmental Policy Act of 1969.

___ A. One or more ___ historic, ___ architectural and/or ___ archaeological sites listed in or eligible for the National Register of Historic Places may be affected by the project. Please coordinate with this office.

X B. These portions of the project should be coordinated with this office:

- ___ 1. Structural rehabilitation/revitalization
- X 2. Acquisition
- X 3. Demolition
- X 4. Land Development
- ___ 5. Other (see below)

___ C. Our office should be supplied with the following information:

- ___ 1. County, city, or USGS quad map indicating the precise location of the project.
- ___ 2. Description of the land and its past and present land use
- ___ 3. Front and rear elevation photos of structures to be affected by the project.
- ___ 4. Photographs of the streetscape in the project area.
- ___ 5. A copy of the ___ history/architecture and/or ___ archaeological survey(s).
- ___ 6. Date of construction of any structures on the site.

___ D. A ___ history/architecture and/or ___ archaeological survey of the project area is recommended for the following reasons:

- ___ 1. The Ohio Historic Inventory and the Ohio Archaeological Inventory are incomplete and we cannot state positively that cultural resources will not be affected. Properties which may be eligible for the National Register need to be identified.
- ___ 2. This is an archaeologically sensitive area (see attached) and the development of undisturbed land has potential for affecting undiscovered archaeological resources.
- ___ 3. This is an architecturally sensitive area.

___ E. Applicant should follow OEPA Procedures for Archaeological and Historic Preservation.

X F. Other: FURTHER COORDINATION WITH THIS OFFICE WILL BE NECESSARY ONCE SPECIFIC LOCATIONS ARE PROPOSED OR SELECTED.

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United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

ER 94/349

JUN 17 1994

Major Tracy Bailey
Ballistic Missile Defense Organization
Department of Defense
Post Office Box 4140
Gaithersburg, Maryland 20885-4140

Dear Major Bailey:

The Department of the Interior has reviewed the Draft Programmatic Environmental Impact Statement for Ballistic Missile Defense and has the following specific comments.

001 2.3.1.2 Description of Alternatives, Ground and Space-Based Sensors and Ground and Space-Based Interceptors System Acquisition Alternative, GBI Development and Testing, Pages 2-15 through 2-16. Text in this section indicates that Safety analyses would be conducted to ensure that any missile debris would fall in predetermined areas to avoid endangerment of human health and safety. The Service recommends adding "... and to avoid or minimize harm to environmentally sensitive resources."

002 The next paragraph states that debris falling on land would be recovered whenever possible. In some environmentally sensitive areas, impacts associated with debris recovery may be greater than those associated with debris impact or deterioration. The text should be amended by adding "... except in areas of extreme environmental sensitivity. Natural resources agencies will be consulted for input into recovery activities."

003 Table 2-1, Biological Resources and Wetlands Page 2-29. It is recommended that a clause be added stating that formal consultation procedures will be initiated with our U.S. Fish and Wildlife Service (Service) before beginning any activity that may affect species listed as endangered or threatened under the Endangered Species Act, or their designated critical habitat. In addition, formal conferencing procedures should be initiated before any activity that may jeopardize the continued existence of any species proposed for listing, or modify or adversely affect critical habitat proposed for those species.

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004 2.7.1 Comparison of Alternatives, Summary of Environmental Consequences of the Preferred Action, Pages 2-31 through 2-32. This section states that solid debris from ground-based interceptors, spent targets and jettisoned rocket stages could fall on land or surface water under missile trajectories. The text also indicates that because missile trajectories would generally be over uninhabited desert (or open water), falling debris would not represent a source of surface water contamination. Water sources in the West and Southwest are often isolated ecosystems and as such may support populations of species that are very sensitive to impact. Many of the native species inhabiting natural water sources of the West and Southwest are currently listed or are being reviewed for listing under the rules of the Endangered Species Act. The final statement should address the potential for impacts to these sensitive species and discuss in this and following sections (specifically section 4.7), methods for avoiding impacts.

005 3.4.2 Affected Environment, Hazardous Materials and Waste Management, Issues and Concerns, Page 3-23. The portion of this section discussing accidental releases of hazardous materials and wastes to the surrounding environment states that risk to humans resulting from an accidental release depends on the amount and toxicity of the wastes, the media to which they are released and the proximity of the release to human populations. Our Service recommends an additional sentence be added to the final statement indicating risk to natural resources resulting from an accidental release would depend on the amount and toxicity of the wastes, the media to which they are released, and the proximity and type of species affected by the release.

006 3.7.2.1 Surface Water, Issues and Concerns, Surface Water Quality, Page 3-35. This section states that adverse impacts resulting from impaired surface water quality includes toxicity to aquatic biota. While water quality would certainly affect aquatic biota, these are not the only species that could be affected by contamination. Surrounding riparian vegetation and terrestrial vertebrates that could use the water source should also be addressed, including those further up the ecological food chain that could be indirectly affected (i.e., vegetation affected by toxic chemicals being grazed by ungulates, that may be consumed by predators).

007 3.11.1 Biological Resources, Definition of Topic, Pages 3-52 through 3-53. The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d, 54 Stat. 250, as amended) is another Federal statute protecting resources that may be impacted by activities associated with BMD. This statute should be added in the final statement.

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Page 3

008 3.11.2.1 Issues and Concerns, Natural Habitats, Page 3-54. This section lists destruction of slow-moving or immobile species as one of the issues pertaining to natural habitats. While these species are certainly at risk, mobile species may also be at risk for impact. Types of impacts that should be considered include electrocution of raptors on electric powerlines and disturbance to nesting (nest abandonment) or mating behavior in avian species from low-level missile trajectories or other activities.

009 3.11.2.2 Threatened or Endangered Species, Page 3-54. Our Service recommends changing the second sentence to read "... undiscovered economic importance or importance to the ecosystem in which they exist."

010 3.11.2.3 Migratory Birds, Page 3-55. Our Service recommends that potential impacts from disturbance through harassment by low-level or through canyon flights be added to this section.

011 3.11.4.1 Natural Habitats, Page 3-55 through 3-60. Intermittent playa lakes in the south central U.S. are a valuable wildlife habitat resource second only to the Gulf of Mexico coast in importance to waterfowl. Studies have indicated that over 21 million ducks may use playas of the Central Flyway. Playa lakes are also extremely important to other migratory waterfowl and shorebirds such as herons, avocets and sandhill cranes. In addition, species listed or under review for listing, also occur on playa lakes as residents or during migration. Congregations of waterfowl attract predator species such as raptors, raccoons and coyotes. Populations of small mammals, such as rodents, tend to be concentrated near playa lakes, making the areas even more attractive to predator species.

This important habitat type should be discussed, either as an integral part of the temperate grassland and desert habitats or under the section discussing "Other habitats."

012 4.0 Environmental Consequences, Pages 4-1 through 4-92. Portions of this section discussing mitigation methods to avoid or alleviate impacts, states that mitigation "could" be undertaken. A strong commitment to all mitigation procedures by changing the text from mitigation "could be undertaken" to read mitigation "would be undertaken" is needed. The final statement should specify those mitigation measures that will be implemented and are to be an integral part of this project.

013 4.4.1.2 Hazardous Waste Materials and Waste Management, Preferred Action, Mitigation Measures, Page 4-24. It is recommended that a statement be added to indicate that natural resource agencies including our Service would be notified in the event of an accidental release of hazardous materials.

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014 4.5 Noise, Pages 4-28 through 4-32. This section does not address potential impacts to natural resources associated with low-level flights of missiles or missile launching platforms, nor mitigation measures to avoid or minimize such impacts. Impacts from such sources should be added to discussions contained in the draft statement including those associated with over or through canyon flights.

015 4.11 Biological Resources and Wetlands, Page 4-59. The discussion at the beginning of this section should include impacts through disturbance to nesting birds, including nest abandonment and the potential for crushed eggs from startled birds.

016 4.11.1.2 Mitigation Measures, page 4-63 through 4-64. Mitigation measures discussed in this section should include restriction of off-road vehicle use, coordination with natural resource agencies for debris recovery, restrictions to low-level flights, measures to avoid electrocution of or collision hazard to avian species and evaluation of soils for erosion impacts.

017 Appendix G, Page G-8. Section 7 of the Endangered Species Act requires Federal agencies to ensure that any action "authorized, funded, or carried out" will not jeopardize the continued existence of a species listed as endangered or threatened or result in adverse modification of designated critical habitat. The Endangered Species Act also requires Federal agencies to consult with our Service regarding any project that may affect a listed species or to confer with the Service regarding any action that may jeopardize a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. Appendix G should be modified to reflect these requirements.

Sincerely,

Jonathan P. Deason
Director
Office of Environmental Policy
and Compliance

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GOVERNOR'S OFFICE OF PLANNING AND BUDGET
Resource Development Coordinating Committee

Lynne N. Koga, CPA
Office Director
Brad T. Barber
State Planning Coordinator
Rod D. Millar
Committee Chairman
John A. Harja
Executive Director

116 State Capitol
Salt Lake City, Utah 84114
Phone (801) 538-1027
Fax (801) 538-1547

May 31, 1994

Major Tracy Bailey
BMDO/AQT
7100 Defense Pentagon
Washington, DC 20301-7100

SUBJECT: U.S. Army Ballistic Missile Defense Draft Programmatic EIS
State Identifier Number: UT940418-010

Dear Maj. Bailey:

001 The Resource Development Coordinating Committee, representing the State of Utah, has reviewed this Draft Programmatic Environmental Impact Statement. The State has previously commented on the draft environmental work for the theater missile portion of the ballistic missile defense system. A copy of the State's response to that work is attached for your review.

The Committee appreciates the opportunity to review this proposal. Please direct any other written questions regarding this correspondence to the Utah State Clearinghouse at the above address or call Carolyn Wright at (801) 538-1535 or John Harja at (801) 538-1559.

Sincerely,

for Brad T. Barber
State Planning Coordinator

BTB/ar

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State of Utah
GOVERNOR'S OFFICE OF PLANNING AND BUDGET

Michael O. Leavitt
Governor
Lynne N. Koga, CPA
Director
Brad T. Barber
Deputy Director

116 State Capitol
Salt Lake City, Utah 84114
(801) 538-1027
Fax: (801) 538-1547

UTAH

March 25, 1994

U.S. Army Space and Strategic Defense Command
ATTN: CSSD-EN-V (Mr. David Hasley)
PO Box 1500
Huntsville, Alabama 35807-3801

SUBJECT: U.S. Army Strategic Defense Command: Theater Missile Defense
State Identifier Number: UT930408-030

Dear Mr. Hasley,

The Resource Development Coordinating Committee, representing the State of Utah, has reviewed this proposal. Comments received from state agencies are as follows:

Division of Wildlife Resources

We feel the Army needs to address the issues associated with both the launch site and booster drop zone. Potential disturbance to wildlife includes: noise at launch site and from sonic booms; retrieval of the booster section; securing the impact area; reconnaissance of the impact zone; and contamination from unexpended fuels. Time of year, method of retrieval, increase of long-term access to an area, reclamation of disturbed areas and methods used to secure and monitor the booster drop zone are issues to evaluate. Other issues include identifying hazardous materials associated with the launch site, booster section and tracking, and retrieval equipment.

Because of the inability to more precisely define the Region of Influence (ROI), we feel there is good reason to discuss the habitat and issue associated with the launch site and entire flight path. This entire area is subject to impact and should be considered part of the ROI. The Colorado and Green rivers are in close proximity to the launch site, booster drop zone and lie under the flight path. Species of concern that are associated with these rivers include wintering bald eagles, Colorado squawfish, bonytail chub, razorback sucker, humpback chub, roundtail chub and flannelmouth sucker.

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David Hasley
U. S. Army Space and Strategic Defense Command: Theater Missile Defense
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Launch Site

In the documentation, the Army didn't provide identification of baseline wildlife habitat information for the area of the launch site and surrounding the launch site. Is new construction planned that will destroy some wildlife habitat? Our data is limited for the Green River site. Our data show the surrounding area as potential year-long antelope habitat, but only a few antelope occur in the vicinity. Potential ferruginous hawk habitat also surrounds the site. There may be other species in the area. The Army needs to provide that information.

Impacts from noise associated with launches should be discussed. Impacts could occur to nesting raptors, waterfowl using the Green River, wintering bald eagles and other species that may be identified as inhabiting the area. With the launch area in close proximity to the Green River, all hazardous materials should be contained on-site. Impacts to threatened, endangered or sensitive Colorado River endemic species should be considered.

Booster drop zone

The geographic areas of Hatch Point and Harts Point (identified booster drop zone study area) includes sage grouse strutting grounds; antelope fawning and critical winter habitat; critical and high priority deer winter range; desert bighorn sheep habitat, which should be considered critical habitat; as well as Mexican spotted owls, golden eagles, peregrine falcons, and red-tailed, Swainson's and ferruginous hawks. Raptor surveys conducted in 1992 included sightings of ferruginous hawks, golden eagles, peregrine falcons and red-tailed hawks.

The Division of Wildlife Resources Big Game Board authorizes Limited Entry Buck hunts in September, October and November in the Elk Ridge area and an antelope hunt on Hatch Point (mid-September for one week). Hunters are in isolated areas and may be difficult to locate for evacuation. Who's responsibility would evacuation be? Would there be compensation for people who's recreational activities are curtailed or prevented from this activity? For these particular hunts, hunters must hunt in specific areas during specific times.

The likelihood of a significant impact to the wildlife species mentioned depends on the activities associated with this project.. Seasonal timing is an issue that can create short and long-term impacts. Short-term impacts may be to individuals. These individuals may be lost to the population for

various reasons. Increased stress resulting in disease mortality, abandonment of critical habitats such as water, foraging areas, fawning or lambing areas and abandonment of nests causing mortality of egg or nestlings are examples of impacts due to disturbance. Lost individuals result in a long-term impact to the population due to reductions in the population's reproductive and recruitment capabilities. This type of impact could be significant in the case of threatened or endangered species. We recommend early formal or informal consultation with the U.S. Fish and Wildlife Service concerning threatened and endangered species.

The methods used to secure the booster impact area, monitor the impact zone to determine the impact sight and retrieve the booster section will determine the severity of disturbance. These are issues that must be evaluated. Building new roads to access the impact zone would be the most severe disturbance. The use of helicopters could provide a short-term impact to some of these species. Repeated flights by helicopters could be an impact to the big game species; but, in general, deer, antelope and desert bighorn sheep will be less disturbed by this method than ground retrieval that might include building more roads or opening up snow-closed roads. In contrast, helicopters could be an impact to nesting raptors due to collisions with individuals or egg or nestling mortality due to nest abandonment. Knowledge of the impact/retrieval zone and surrounding wildlife habitat issues should dictate the use of the least impacting retrieval method. Impacts at the booster drop zone and ROI are not limited to the retrieval stage. If repeated flights are necessary to secure the booster drop zone or provide reconnaissance, then this would be a potential source of impacts.

The seasonal dates of most concern are as follows:

Species/season	Date
antelope/fawning	5/15 to 6/15
antelope/winter	severe winter conditions
mule deer/winter	12/1 to 4/15
desert bighorn/lambing	4/1 to 5/31
desert bighorn/summer	water sources are critical
desert bighorn/rut	11/1 to 12/31
peregrine falcon/nesting	2/1 to 8/31
ferruginous hawk/nesting	4/10 to 6/15
Mexican spotted owl/nesting	2/1 to 8/31
sage grouse/nesting & brooding	3/15 to 6/30

Guidelines to reduce the impacts of seasonal disturbances include 0.5-mile buffer zones for most raptor species and 1-mile buffer zone for peregrine

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falcon eyries. If activities are expected to occur between February 1 and August 31, nesting raptors will be an issue. Because of the potential for nest abandonment, surveys should be conducted prior to these activities occurring. The Division can provide guidance regarding these and other surveys if needed. Impacts to habitat within a 2-mile radius of a sage grouse lek should be considered significant. All water sources are considered critical habitat and disturbances should be avoided near these sources during the antelope fawning period and yearlong for desert bighorn sheep.

Indirect and direct impacts and cumulative impacts associated with this proposed action need to be thoroughly evaluated. Opening new access or improving access to this project area is an issue that must be addressed. Any retrieval method that would result in long-term increased access could cause significant impacts due to the sensitive nature of these species. A detailed analysis of direct and indirect impacts due to opening roads needs to be conducted. Impacts as a consequence of increased human activities can be reduced by reclaiming and reseeding new roads. No road construction would be the best means to minimize impacts. Reclamation of all disturbed areas should be a standard incorporation. Cumulative impacts associated with other activities occurring in the project area include oil and gas exploration and development, recreation activities and grazing.

Consideration should be given to mitigation potentials, such as: choosing less-damaging paths for the missiles to follow by looking at terrain and habitat types and avoiding highly sensitive habitats in the flight path; minimizing impacts by choosing low-impact retrieval methods as discussed above; minimizing disturbance by avoiding launches during critical seasons as listed above; conducting reconnaissance of expected flight paths immediately prior to launches to look for sensitive wildlife activities such as nesting, lambing, etc; doing some water or habitat developments to improve wildlife habitat, perhaps outside of the Region of Influence, and minimize some of the cumulative impacts to wildlife.

The Division is willing to work with the Army throughout this EIS process to provide any wildlife information we can. If GIS mapping is required, there will be a charge. For specific information, they should contact the Habitat Manager, Ken Phippen, in the Southeastern Region office at (801) 637-3310.

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State Lands and Forestry

A right of entry from the Division of State Lands and Forestry will be required if the Green River Launch Site is to be used. Our preference would be for a one time payment up front for all trust land acreage in the potential Final Drop Zone for 1994-1999.

The three to six mile radius of booster impact zones (page 3-37) likely will include state school trust lands. these lands are managed by the Division to generate revenue to support education in Utah. The assessment of significant impacts at booster impact zones resulting from launches at the Green River Launch Complex (GRLC) appear to focus on disruption of recreational pursuits (pages S-3, 2-96, 4-280). More that just recreation is occurring on land in booster impact zones. For example, the oil and gas exploration and development occurring in the Kane Spring area is an important revenue generating activity. This area includes Booster Impact Zone A (pages 2-36). The assessment of significant impacts would be more complete if Booster Impact Zones A and B were included in the Region of Influence for the discussion on land use for the GRLC (section 2.1.2.8, page 3-63). This would allow for an assessment of the impacts from disrupted mineral exploration and development activity.

Governor's Office of Planning and Budget - Demographic and Economic Analysis

The Governor's Office of Planning and Budget (GOPB) has concluded that the socioeconomic analysis does not provide sufficient information about either the economic impacts of or the magnitude of disruptions caused by launching missiles from Green River, Utah. The final EIS should be more comprehensive and inform decision-makers and the public about the broader economic, fiscal, and cultural issues associated with missile testing in Utah. Specifically, the draft EIS should include a more thorough discussion and analysis about, 1) the ultimate economic impact, 2) the effect on tourism activity in the area, and 3) the magnitude and character of the disruptions that will occur as a result of the testing. Each of these concerns is described separately below.

<u>Economic Impact</u>

The DEIS provides two measures of the economic impact of the testing: the direct restaurant and motel expenditures that would be made by launch personnel ($1.2 million) and the employment that would be generated from

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construction of facilities (40 people over two months). While these estimates may be reasonable, they are incomplete and presented in a manner that denies readers and decision-makers a clear understanding of the true economic impact. The DEIS misrepresents the economic impact by ignoring tourist displacement and excluding the impacts of construction jobs, in-state construction purchases, ties with Hill Air Force Base for the shipping of missile components, and the indirect and induced impacts. The DEIS could be improved by incorporating the following:

1) Including only that portion of restaurant and motel expenditures that are made by missile testing personnel that are over and above expenditures that would occur during typical visitation. From an economic perspective, the only impact that is relevant is the new activity that will occur. This point is not made clear in the DEIS.

2) Recognizing in the economic impact section that testing that occurs in the prime tourism season will certainly crowd-out tourists. The DEIS notes that camping areas should help to minimize the competition between launch- and tourism-related demands (p. 4-67). During prime tourism season this is entirely incorrect, since most camping areas are already full. The notion of substituting camping for hotel accommodations also fails to recognize that many visitors that use hotels do not camp or may not be prepared to camp after they find no rooms are available.

3) Estimating the incremental earnings and employment that would be generated because of increased economic activity from the launch. The DEIS includes only expenditure and construction job measures of economic activity. These measures are inadequate because they don't show the <u>total</u> job and earnings impact on the impacted area. Construction impacts should include not only the anticipated jobs, but the effect of construction purchases, to the extent that they occur, in the local economy. Impacts should also include estimates of direct and indirect activity.

4) Expressing the economic impacts in a more straightforward manner. Readers should be able to look at one page in the environmental consequences section and find the total estimated expenditures, employment, and earnings from the proposed alternative. Currently, the construction job impacts are not even noted in the environmental consequences section, but are buried in the description of alternatives in Section 2.0.

David Hasley
U. S. Army Space and Strategic Defense Command: Theater Missile Defense
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5) Summarizing the fiscal impacts of the missile testing on the affected area. Local government budgets in Grand and Emery County have been significantly affected by the downturn in the natural resource industry. These counties are increasingly more dependent on tourism revenues. The missile testing will bring additional motel, eating and drinking, retail trade, and other economic activity. Much of this activity is taxed and should be quantified for the final EIS. These taxes include transient room tax, sales tax, property tax, eating and drinking tax, fees, and charges. The final EIS should specify whether the Army plans to directly compensate local governments for public safety or any other public service provided locally during launches. The final EIS should provide state and local government with information about any additional costs that government may incur because of missile testing.

6) Providing any other relevant information about economic impacts such as compensation that may be paid to private land owners and permittees affected by the launches, the impacts of re-routing air traffic during launches, and the oil and gas potential of state lands within drop sections.

Tourism Activity

While the DEIS notes the importance of the tourism industry to the impacted area and lists visitor counts in the Appendix, the role of tourism in the economy should be more completely described in the Affected Environment section and the future impacts on tourism should be more carefully analyzed in the Environmental Consequences section. The final EIS should make it eminently clear that certainly in Moab, and increasingly in Green River, tourism is a major contributor to the economy and culture of the area. This is extremely relevant since planning and decision-making in the area, including choices about the missile testing, must recognize the importance of tourism in the area.

Canyonlands and Arches National Park alone attracted 1.2 million recreation visits during 1992. Visitation at these two national parks has increased by 10% per year since 1981. Room rents in Grand County increased at a rate more than double the state average over the past decade. The travel, tourism and recreation industry is the largest provider of jobs in the Grand County economy, accounting for nearly 27 percent of all jobs. This is more than twice the share tourism represented a decade ago. The growth, popularity and/or success of mountain biking, foreign tourism, river recreation, marketing efforts, and the Utah Film Commission have all helped Grand County emerge as the second most tourism dependent county

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in the state. Communities in close proximity to Moab, such as Green River, will likely experience similar changes over the next decade.

The point is that the DEIS must recognize this dramatic transformation and describe how missile testing adjacent to and within this tourism mecca will impact tourists and the local communities. Even if this relationship between tourism and missile testing cannot be precisely quantified, it should, at a minimum, be described and issues relating to the conflicts highlighted.

Magnitude of Disruptions

The DEIS inadequately describes and entirely understates the magnitude and character of community disruptions that will occur because of missile testing. Restricting recreational access to Canyonlands National Park, Dead Horse Point State Park, and adjacent lands is a significant disruption. The DEIS provides no estimates of how many travelers will be affected or analysis of the nature or character of the disruptions. The final EIS should more clearly describe how long disruptions will last; how visitors will be notified; how much advance notice people will receive; and how the public will have input on when disruptions occur. The final EIS could be improved by providing the reader with a likely disruption scenario that describes how tourists will be impacted.

Similar issues are relevant to the closure of I-70. How long of a wait will occur, how many vehicles will this affect, how will travelers be notified, and what will be the impacts on alternative routes? It is not entirely unreasonable for the public to expect the EIS to estimate the economic cost in terms of man-hours that will occur because of closing I-70. I-70 is a major east-to-west route for interstate and intrastate trade. The distribution of goods from regional economic centers such as Grand Junction, Salt Lake, Price, Richfield, St. George and others will be impacted during missile launches. The DEIS simply does not provide enough information about the nature and magnitude of disruptions because of road closures.

Governor's Office of Planning and Budget - Planning

In the Draft EIS, the Army evaluated four potential launch locations. Each having its own peculiar set of strengths and weaknesses. In the particular case of the Green River - Fort Wingate launch alternative there were significant land use and health safety impacts identified. Based on public

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comments received so far, the Army has indicated that they are evaluating two significant changes. One is to move the launch site location (and thereby reduce the launch hazard area) with the possibility of keeping I-70 open during a launch. The other is a change in the flight trajectory of the target missile allowing for a potential change in the stage 1 booster drop zones. Each of these changes is designed to mitigate significant impacts previously identified in the Draft EIS and public comment.

On the surface it appears that the Army is being responsive to the needs of the State and that this seems to be what the State wants. However, the problem with this approach is that the new launch site and booster drop zones have not been identified at this time. Consequently, state agencies and the public are not given the opportunity to comment on additional potential impacts.

Once the new alternative locations have been evaluated, the Army should republish the Draft EIS and conduct another comment period after the State has had the opportunity to study the new proposal and before publishing the Final EIS.

Governor's Office of Planning and Budget - Science Advisor

In the Draft EIS, little discussion of the probability and potential effects of non-routine type testing and errors was provided. For example, little mention was made of the cases proposed for later phase testing involving multiple target and/or defensive missile flights to validate specific defensive missile performance. What is the additional risk associated with multiple target firings and therefore misfires? If the decision is made to conduct these tests what data does the Army have of the trajectory and flight paths of multiple targets? Will significant statistical data be gained by the inclusion of these tests?

No data on the reliability of the models and therefore the predictability of the trajectory and flight path of the missiles was provided. The possibility of errors was given with planned early flight termination of the missile mentioned. What is the probability of the need for the flight termination system and what will be the destination of material which falls as a result of early termination? Do the current data validate that off course termination tests will not impact areas not defined as the ROI or flight path?

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The same concerns are involved in the use of other extended range test flights with bomblets. The inert materials will still have effect on the destination location, i.e. in the case of the dispersion of simulant which may be necessary for early termination tests. Has testing or modeling of this dispersion be done? It has not been provided in the Draft EIS.

Has the potential for misfire or off course flight of the meteorological Viper IIIA rockets been included in the determinations of risk and impact?

The Committee appreciates the opportunity to review this proposal. Please direct any other written questions regarding this correspondence to the Utah State Clearinghouse at the above address or call Carolyn Wright at (801) 538-1535 or John Harja at (801) 538-1559.

Sincerely,

Brad T. Barber
State Planning Coordinator

BTB/ar

Table 8-1. List of Commentors/Requestors (Sheet 1 of 6)

				Program Interest		
Document Number	Name/Organization	Response Page No.	Comment Document Page No.	Comment	Request for DPEIS/ES	Other
0001	Mr. Peter Bangina	8-2	8-5	●	●	
0002	Professor Mark Freeman	8-2	8-5	●		
0003	Not Assigned					
0004	Mr. Joseph Sheffman	8-2	8-5	●	●	
0005	Senator Bill Riggins (Retired)	8-2	8-6	●	●	
0006	Mr. Gabriel Membiela	8-41	8-6	●		
0007	Mr. Gabriel Membiela	8-41	8-7	●		
0008	Mr. Paul Foer	8-41	8-7	●	●	
0009	Mr. Jeffrey Roeder	8-41	8-7	●		
0010, 0011	Not Assigned					
0012	Mr. Robert S. Bennett	8-41	8-7	●		
0013	Mr. Bennett Rutledge	8-41	8-8	●		
0014	Mrs. Jeanette Furney(1) State of North Carolina			●		●
0015	Not Assigned					
0016	Anonymous	8-41	8-8	●		
0017	Mr. Philip Brady	8-41	8-8	●	●	
0018	Mr. Kocsis	8-41	8-8	●		
0019	Mr. John Wright	8-41	8-9	●		
0020	Mr. Roland E. English, III(1) State of Maryland	8-41	8-9	●		●
0021	Mr. Richard B. Cathcart	8-41	8-9	●		
0022	Not Assigned					
0023	Mr. Michael Austin	8-41	8-9	●		
0024-0030	Not Assigned					
0031	Mrs. Suzanne Traub-Metlay(1) State of Florida			●	●	●
0032	Not Assigned					
0033	Mr. Matthew J. McGuire	8-42	8-10	●		
0034	Mr. Eddie Becker	8-42, 43	8-10, 11	●		
0035	Mr. Robert Kennedy	8-42	8-10	●		

Table 8-1. List of Commentors/Requestors (Sheet 2 of 6)

Document Number	Name/Organization	Response Page No.	Comment Document Page No.	Program Interest: Comment	Program Interest: Request for DPEIS/ES	Program Interest: Other
0036	Mrs. Lois Pohl State of Missouri	8-43	8-11	•		
0037	Mr. Paul Foer	8-43	8-12	•		
0038	Mr. Harold Geltman(2)					•
0039	Mr. Thomas B. Killeen	8-43	8-12	•		
0040	Mr. Dave Koresh(2)					•
0041	Dr. Roger A. Sabbadini San Diego State University	8-42	8-12, 13	•		
0042	Mr. Harold Geltman(2)					•
0043	Mr. Richard E. Sanderson U.S. Environmental Protection Agency	8-43, 44	8-13, 14	•		
0044	Mr. Lawrence Stice	8-44	8-14	•		
0045	Ms. Holly Jenkins	8-44	8-14	•	•	
0046	Not Assigned					
0047	Mr. Michael Jones	8-(44-48)	8-(15-19)	•		
0048, 0049	Not Assigned					
0050	Ms. Holly T. Jenkins	8-48	8-19, 20, 21	•		
0051	Mr. Walter F. Hallett	8-48	8-21, 22, 23	•		
0052	Mrs. Leone Hayes	8-48	8-23, 24	•		
0053	Ms. Dollie Irwin/ Ms. Carolyn Toenjes	8-49	8-24	•	•	
0054	Mr. Harold Geltman(3)	8-49, 50	8-25, 26	•		
0055, 0056	Not Assigned					
0057	Mr. Stephen Klokkenga(1) State of Illinois	8-50	8-26	•		•
0058	Mr. Donald P. Panzera(1) Library of Congress	8-50	8-27	•		•
0059	Ms. Susan Goggin(1)			•		•
0060	Ms. Gearldean Wynkoop(1) The George Washington University	8-51	8-27	•		•
0061	Mrs. Chrys Baggett State of North Carolina	8-51	8-27, 28, 29	•		

Table 8-1. List of Commentors/Requestors (Sheet 3 of 6)

				Program Interest		
Document Number	Name/Organization	Response Page No.	Comment Document Page No.	Comment	Request for DPEIS/ES	Other
0062	Not Assigned					
0063	Mr. Estus D. Whitfield State of Florida	8-52	8-29, 30	●		
0064	Mr. Larry W. Weaver[1] State of Ohio	8-52	8-30, 31	●		●
0065, 0066	Not Assigned					
0067	Mr. Jonathan P. Deason U.S. Department of Interior	8-52, 53, 54	8-31, 32	●		
0068-0070	Not Assigned					
0071	Mr. Brad T. Barber[1] State of Utah	8-54	8-32, 33, 34	●		●
0072	Holly Jenkins[4]					●
List of Requestors in Chronological Order as Received						
Mrs. Marguerite Duffy U.S. Environmental Protection Agency					●	
Mr. Parker					●	
Mr. Jim Chaconas					●	
Mr. James G. Bach					●	
Dr. Jonathon P. Deason[1] U.S. Department of Interior					●	●
Mr. David K. McGuire					●	
Mr. Mark Smalders Sierra Club Legal Defense					●	
Mrs. Gwen Wilder U.S. Department of Interior					●	
Orbital Sciences Corporation					●	
Mr. Steve Ericson Downwinders, Inc.					●	
Mr. Harry Bryson					●	
Mr. Max (no last name)					●	
Mr. John DiMarzio					●	
Mr. Stanley Fujioka					●	
Mr. Philip Flemming					●	
Mr. Rick Santacruz					●	
Mr. Jeff Light					●	

Table 8-1. List of Commentors/Requestors (Sheet 4 of 6)

				Program Interest		
Document Number	Name/Organization	Response Page No.	Comment Document Page No.	Comment	Request for DPEIS/ES	Other
	Mr. Chris Simpson				•	
	Mr. Michael F. Graham				•	
	Mrs. Vicki Lathom				•	
	Mr. Robert Meagher				•	
	Mr. Ron Kear				•	
	Mr. Tom Adams				•	
	Mr. Al Stern				•	
	Mrs. Louisa McAllister				•	
	Mr. Kenny Smith				•	
	Mr. Chris Giavines				•	
	Mr. William Ferroggiaro				•	
	Mr. Eric Dahlstrom				•	
	Mrs. Monica Garia				•	
	Mr. Andrew Bubsy				•	
	Mr. Nick Nichols				•	
	Mrs. Claire J. Biehl				•	
	Mr. Vincent Kiernan				•	
	Mr. George Mason				•	
	Mr. James Kinnahan				•	
	Apt Research				•	
	Mr. Arnold Kramish				•	
	Mr. Henry Brokenoka				•	
	Mr. Bucky Tart				•	
	Anonymous				•	
	Mr. Dennis Foley				•	
	Mr. Eric Anderson National Guard Bureau				•	
	Mrs. Andrea Zeller				•	
	Mr. Karl Miller				•	
	Mr. Benjamin				•	
	Mr. Robert Haddon				•	
	Mr. Harry Wilson				•	

Table 8-1. List of Commentors/Requestors (Sheet 5 of 6)

				Program Interest		
Document Number	Name/Organization	Response Page No.	Comment Document Page No.	Comment	Request for DPEIS/ES	Other
Mr. Des Sood					●	
Mr. Leon					●	
Mr. Andrew Tonkovich					●	
Mr. Jeff Holste					●	
Mr. Matthew Socha					●	
Mr. Dave Velario					●	
Mr. Randy Clouette					●	
Mr. James Gerald					●	
Mr. Arthur Felix					●	
Mr. John Davis					●	
Mr. Lamyrt Burison					●	
Mrs. Carol P. Jahnkow					●	
Mr. Tom Ray					●	
Mr. Steven Dolley					●	
Mr. Ben Partin					●	
Mr. Don Summers					●	
Mr. Guy A. Best					●	
Mr. James Spriggs					●	
Mr. Karl Grimm					●	
Mr. Thomas McQue					●	
Mr. Samuel Freiberg					●	
Mr. Wilson G. Johnson					●	
Mr. Jay H. Colier					●	
Mrs. Maria Stephens					●	
Prof. Lawrence Roberts					●	
Mr. Thomas Killeen					●	
Mr. Richard Meier					●	
Mr. George Noyes					●	
Mr. Jim Brown					●	
Mrs. Angela Hitti					●	
Mrs. Claire J. Biehl					●	
Dr. Roger A. Sabbadini					●	

Table 8-1. List of Commentors/Requestors (Sheet 6 of 6)

				Program Interest		
Document Number	Name/Organization	Response Page No.	Comment Document Page No.	Comment	Request for DPEIS/ES	Other
Mr. Patrick Moran					•	
Mrs. Ellen Thomas					•	
Mr. Anthony Adduci U.S. Department of Energy					•	
Mr. Bill Tennenbaum					•	
Mr. Robert L. Martinez					•	
Mr. David Ingram[1]						•
Mr. Stephen M. Austra					•	
Mr. Jack Metzler					•	
Mr. Rick Blasing					•	
Mr. Netai Basu					•	
Mr. Tom Devine[1]						•
Mr. Myles Turnbaugh					•	
Major Michael B. Parlor					•	
Mr. Patrick L. Huddie, Ph.D.					•	
Mr. Steve Dietrich					•	
Terry Wolfe					•	
Mr. Gary Stone					•	
Mr. James Muncee Space Frontier Foundation					•	
Ms. Marguerite Duffy[1] U.S. Environmental Protection Agency						•
Ms. Valerie Barnes					•	
Mr. Lili C. Kudo					•	
David Bryant					•	
Mr. Mike Werner					•	
Mrs. Jeanette Furney State of North Carolina					•	
Ms. Linda L. Shelley[1] State of Florida					•	

(1) Duplicate comment submittal, transmittal of information only, or requested/received non-program-related information.
(2) Documents received which were outside the scope of, or not relevant to, the BMD Program.
(3) Lengthy submittal; only pages containing comments were included in Exhibit 8-1.
(4) Documents received after public comment period.

0006.001 It is unreasonable to assume that a program of the size and complexity of the BMD Program would not have some impact on the environment. The purpose of the BMD PEIS is to determine what environmental impacts the Preferred Action and System Acquisition Alternatives may have, and to identify measures which could be used to mitigate their impacts. This analysis will permit the decision maker to select the alternative which will best meet program objectives and still result in acceptable impacts to the environment.

0007.001 See response number 0006.001.

0008.001 The Council on Environmental Quality (CEQ) regulations implementing the NEPA (40 CFR 1506.6 Public Involvement and 40 CFR 1503.1 Inviting Comments) require public notification of federal action and the solicitation of public comments on the proposed action. Press releases and the NOA provided information on the date, time, and location of public hearings and document availability. Public service announcements were also submitted to both hearing locations. Chapter 1 of the PEIS fully explains the mission of the BMDO and its relationship to the Department of Defense (DoD).

0009.001 Comment noted.

0012.001 Comment noted.

0013.001 Comment noted.

0016.001 Comment noted.

0017.001 Comment noted.

0018.001 Comment noted.

0019.001 Comment noted.

0020.001 Comment noted.

0021.001 Comment noted.

0023.001 CEQ regulations implementing NEPA (40 CFR 1506.6 Public Involvement and 40 CFR 1503.1 Inviting Comments) require public notification of the Federal Action and solicitation of public comments on the Proposed Action. As the Preferred Action and the System Acquisition Alternatives encompass nationwide sites, national media coverage on the public participation

process was deemed important. The use of a toll-free telecommunications number was initiated to provide all citizens the opportunity to comment.

0033.001 Sections 3.2 and 4.2 of the PEIS have been expanded to include the latest scientific and regulatory issues as of May 1994. A 1993 report prepared by The Aerospace Corporation for the Space and Missile Systems Center entitled *Stratospheric Ozone-Depleting Chemicals Generated by Space Launches Worldwide* states that "by the end of this century, space launches will generate 1 to 2 percent of all ozone-depleting chemicals." (The Aerospace Corporation, 1993). BMDO activities represent only a fraction of the total quantity of ozone-depleting chemicals from space launches. The principal contributors to launch-related ozone-depleting chemicals in the United States are the Space Shuttle and Titan IV vehicles, not the much smaller Minuteman and Delta-class vehicles planned for BMDO purposes. A more detailed discussion can be found in Sections 3.2 and 4.2.

0034.001 300 kilotons of chlorine are released annually from industrial sources worldwide. Text has been amended to state "worldwide."

0034.002 A 1 percent decrease in global stratospheric ozone is estimated to yield a 1.6 percent increase in annual carcinogenic ultraviolet light and a 2.7 percent increase in non-melanoma skin cancer. Therefore, the corresponding health impacts from a 0.1 percent decrease in global stratospheric ozone levels are minimal. The text has been modified to reflect these statistics.

0034.003 The BMD PEIS addresses the Preferred Action and several System Acquisition Alternatives. None of these involve the actual manufacturing of system components for deployment. Later life-cycle phases are discussed, in general, for each alternative. Environmental impacts relating to manufacturing BMD system components will be addressed in environmental analyses tiered to the PEIS.

0034.004 BMDO is committed to reducing hazardous wastes (Section 4.4). Specific quantities of pollutants from the manufacturing of integrated circuits or other components are not known at this time. However, the manufacturing of new units would occur only at government and contractor facilities that are already experienced, equipped, and well-trained in handling hazardous pollutants. Emissions from facilities would be subject to

Prevention of Significant Deterioration and/or new source review permits on a facility-by-facility basis.

0034.005 When siting discussions are initiated, all pollutant emissions will be calculated using approved, standard EPA and NASA modeling techniques. Pollutant emissions will be compared against the respective state and federal emissions standards. Subsequent environmental documentation will be reviewed by federal agencies and will be available to the general public, as was the DPEIS.

0035.001 The NEPA (Section 102(2)) requires that Federal agencies prepare an Environmental Impact Statement (EIS) when their actions have the potential to affect the quality of the human environment. The BMD PEIS was prepared in response to NEPA and covers the Preferred Action and System Acquisition Alternatives, as stated in Sections 1.3.2 and 2.0 of the PEIS. It is not within the scope of the document to discuss the impact of implementation of the BMD system in the event of a missile attack.

0036.001 Comment noted.

0037.001 See response number 0035.001.

0039.001 Comment noted. Chapter 1 discusses the BMDO public involvement process, which fully satisfies the requirements of NEPA.

0041.001 See response to comment 0035.001.

0041.002 A discussion of arms control, diplomacy, international cooperation, and the Strategic Arms Reduction Treaty (START) is outside the scope of this PEIS.

0043.001 Section 4.1.1.1 has been changed to indicate that application would be made for an individual Section 404 permit if a Nationwide General Permit did not apply.

0043.002 Section 3.3.1 of the PEIS has been modified. Text has been added to clarify the measurement units for low frequency electromagnetic radiation (EMR) versus radio frequency EMR.

In addition, qualifiers of "radio frequency" and "low frequency" have been added to clarify the health effect paragraphs.

In both chapters 3 and 4 of this PEIS references to "power densities" have been removed from discussions of low frequency EMR.

0044.001 Comment noted.

0045.001 A discussion of EMR, including potential hazards to human health and safety and effects on animals, is presented in Section 3.3. EMR includes both radar and lasers, although research and testing of the latter are not a part of the Preferred Action or any of the System Acquisition Alternatives. Impacts of EMR emissions associated with the Preferred Action and Alternatives are presented in Section 4.3. All EMR emissions would be in accordance with accepted safety standards.

0047.001 The BMD PEIS complies with the NEPA by exploring and evaluating all reasonable alternatives, including acquisition programs, for an effective National Missile Defense System (NMD) which could violate the current Anti-Ballistic Missile (ABM) Treaty. Section 1502.14(c) of the CEQ Regulations implementing NEPA requires consideration of reasonable alternatives not within the jurisdiction of the lead agency, BMDO. While current national policy is to comply with the ABM Treaty, it is not inconceivable that the treaty would be amended if such action was determined to be in the national interest. This PEIS provides environmental analyses of all reasonable alternatives to help form future decisions. The primary focus of the BMD PEIS is to evaluate the environmental impacts of alternatives that would provide the United States with the capability to produce and deploy an NMD system at some point in the future should it become necessary. A secondary objective is to consider the environmental impacts of the entire BMD Program by discussing the cumulative impacts of both the NMD and Theater Missile Defense (TMD) segments.

As stated in Section 1.1.2.3 of the DPEIS, "Provision of any NMD system other than agreed upon in the ABM Treaty would require modification of the treaty." It is stated further in Section 1.3.6.1 that "The BMDO Program will continue to be conducted in a manner that complies with all U.S. obligations under the ABM Treaty." This reflects current national policy.

0047.002 Under the ABM Treaty, only one ABM system is permitted in the vicinity of an Intercontinental Ballistic Missile (ICBM) Site or one in the National Capital region. The text in Section 1.1.2.3 has been modified to reflect this response. No specific sites other than Grand Forks, North Dakota, have been identified as

potential NMD sites. Site-specific NEPA analyses will be conducted when and if specific sites are identified.

0047.003 As noted earlier, the BMD PEIS evaluates the environmental impacts of reasonable alternatives that would provide the United States with the capability to produce and deploy an NMD system at some point in the future as well as acquisition alternatives that would provide an effective BMD system. While it describes the treaty compliance review mechanism, its purpose is not to discuss substantive treaty compliance issues, which are more appropriately resolved in other forums. An analysis of the interpretation of the ABM Treaty is outside the scope of the BMD PEIS.

0047.004 The commentor's assistance is appreciated in determining what was missing from the Administrative Record for the Strategic Target System (STARS), and in pointing out other instances where the public review process may have been improved.

0047.005 Comment incorporated.

0047.006 The commentor has suggested that the emphasis of the Technology Readiness Program is the development of "critical technologies and capabilities necessary to minimize the time required to deploy an initial system." However, this does not logically imply an intent that this initial system would be designed so as to violate the ABM Treaty. As noted, current national policy is to comply with the ABM Treaty; any deployment of an ABM system will comply with existing national policy and direction.

0047.007 Prior to testing or deployment of any ABM system, including space-based sensors and space-based interceptors, the system would be reviewed through the treaty compliance process discussed in Section 1.3.6.2, or as otherwise directed by national authority.

0047.008 The Preferred Action involves basic research on technologies relevant for missile defense structured toward research and development. The objective of the Preferred Action is to develop long-lead technologies.

0047.009 A discussion of START I and START II restrictions is outside the scope of this PEIS. While current national policy is to comply with START I and START II, it is not inconceivable that these treaties would be amended if it was determined to be in the national interest.

0047.010 Halon 2402 used for launches will be taken from stockpile sources and would not involve further production, which is prohibited by the Clean Air Act (CAA); therefore, it could be used for launches after 1995 without violating the 1990 CAA Amendments. The statement on page 3-13 of the BMD DPEIS that the "use" of Class I ozone-depleting substances is phased out by 1996 is incorrect. The text has been revised accordingly.

0047.011 As was noted in response to the comment on the *Draft Environmental Impact Statement for the Restrictive Easement, Kauai, Hawaii* the applicable standard is the short-term Public Emergency Guidance Level (SPEGL), which will not be exceeded. For a more complete response to this comment, refer to the response to the commentor's comment 5 on page 9-19 of the *Final Environmental Impact Statement for the Restrictive Easement, Kauai, Hawaii* (USASSDC, 1993).

0047.012 Reference to these data has been rewritten in this PEIS with the appropriate reference. Specific linkage to the "STARS EIS" is not necessary and therefore has been omitted (NASA, 1978).

0047.013 The requirement to report lead releases under the Comprehensive Environmental Response, Compensation, and Liability Act for missile launches has not been finally determined; however, the commentor is correct in pointing out that the impacts of lead releases, cumulative and otherwise, must be evaluated irrespective of the reporting requirement.

0047.014 All boosters considered for use in BMD testing activities will have undergone rigorous reliability evaluation. Only highly reliable booster will be used in order to protect the public and to ensure mission accomplishment.

0047.015 Specific range safety issues will be analyzed in future program-specific/site-specific environmental documentation because range safety requirements are different for each range. However, range safety requirements have been based on decades of experience with a myriad of launch situations and missile and booster situations. It would not be particularly helpful to discuss in detail any specific launch incident. It should be noted that each range safety officer evaluates the particular circumstances of the launch to determine at what point a launch must be terminated: either to protect the public or other resources.

With respect to the June 15, 1993 Minuteman I failure at Vandenberg Air Force Base (VAFB), as with all launches, fire hazards must be taken into account and evaluated.

With respect to the 1991 Aries failure, impacts on land were confined within the launch hazard area. The seaward areas within which debris impacted was in an exclusion area under the control of Cape Canaveral range safety.

0047.016 While orbital debris is a concern, it is being studied in different forums. Space is not considered a part of the human environment, consequently it does not require analysis under NEPA.

0047.017 Comment noted.

0047.018 The developed areas are previously disturbed and therefore are unlikely to contain intact archeological resources. The siting in the Continental United States (CONUS) will not be as constrained as were conditions on Kauai Test Facility (KTF). The STARS launch facility, as stated on page 3-28 of the STARS Draft EIS, is adjacent to Nohili Dune and not within a major burial ground; however, the comment is well received. All areas that will be used for BMD activities will be evaluated in site-specific documents to determine what, if any, impacts will be on cultural resources.

0047.019 Land issues will be analyzed in future program-specific/site-specific environmental documentation.

0047.020 Cumulative impacts have been assessed for the sites that the commentor mentioned (Section 4.15) and will be assessed for other sites as they are selected.

0047.021 The cumulative impacts of lead emissions have been previously analyzed to the extent that information was available in the KTF site-specific environmental documents. A monitoring program has been implemented to obtain data for further analysis.

0047.022 Additional discussion of irreversible and irretrievable commitments of resources will be analyzed in future program-specific/site-specific environmental documentation. Land use at the U.S. Army Kwajalein Atoll (USAKA) was analyzed in the USAKA Supplemental EIS.

0047.023 Secret programs that may have a significant impact on the environment are evaluated in classified documents or classified annexes to other documents.

0047.024 BMDO regrets any miscommunication on air monitoring deficiencies that may have been associated with the first STARS launch. However, it should be noted that existing wind conditions on the day of the launch affected the military's ability to adhere rigidly to the monitoring plan.

The air monitoring sites were changed to accommodate anticipated wind directions at the time of the launches. There is no use in placing monitors upwind of a source. A discussion of the proposed environmental standards and procedures for USAKA are beyond the scope of this document.

0047.025 Comment noted.

0050.001 See response number 0045.001.

0050.002 Comment noted.

0051.001 Revegetation undertaken in connection with any ground-disturbing actions would include all necessary steps to ensure the success of such efforts. These steps would be set forth in the site-specific soil erosion and sediment control plan and revegetation contract specifications.

0052.001 A description of each NMD program element is presented in Appendix F. While computers will be an important part of the system, interceptors will not be directed against any threat without an assessment being made by battle managers, thus precluding firing interceptors at explosions or fires on the earth's surface. Surveillance satellite airborne sensors and ground radars would locate targets and communicate tracking information to battle managers and decision makers who would, in turn, verify and validate target assignments to interceptors.

0052.002 A description of element activities is provided in Section 2.2.2 of the PEIS. Sensor and seeker development continues under the Preferred Action. All known atmospheric anomalies will be considered in development and testing.

0052.003 See response number 0035.001.

0052.004 Comment noted.

0053.001 PEISs are used to address broader issues relating to an entire federal program. Descriptions applying to the nature and scope of the PEIS are found in Sections 1502.4, 1508.25, and 1508.28 of the CEQ regulations. These sections indirectly describe the PEIS as a document that identifies for the decisionmaker the environmental effects of actions that are connected, cumulative, or similar. Agencies may tier site project-specific environmental documents from a PEIS, thereby eliminating repetitive discussions and concentrating on issues that are applicable for discussion (40 CFR 1502.20 and 40 CFR 1508.28). The PEIS is particularly relevant for actions that are complex and for actions in which the extent of the environmental effects is essentially unknown.

0053.002 See response number 0053.001.

0053.003 The primary focus of the BMD PEIS is addressed in Section 1.3.2. The history of the BMD Program is discussed in Section 1.1.1. This section distinguishes between the Strategic Defense Initiative and the current BMD Program.

0053.004 Comment noted.

0053.005 While the DoD is concerned about the clean-up of wastes at its various facilities, this is a separate issue from the Preferred Action or any of the System Acquisition Alternatives, and thus is not within the scope of this PEIS.

0053.006 See response number 0001.001.

0054.001 Comment noted.

0054.002 As noted in the introduction to Appendix C, the BMD mailing list includes the names of interested federal, state, and local agencies, and individuals who have expressed an interest in receiving BMD Program documents. These persons and/or organizations expressed interest in the program by contacting BMDO by telephone, facsimile, mail, or in person in order to be placed on the BMD Program mailing list.

0054.003 Table I-1 was included to identify typical hazardous materials and wastes and their potential use in the BMD Program. Information on the potential hazards to human health and safety of a number of toxic and hazardous substances is presented in Table J-1.

0054.004 Adding the suggested column (Environmental Educational Health Prevention Steps) to Table J-1 is not necessary at this stage of environmental documentation. A general discussion of mitigation measures related to safety issues is presented in Section 4.6.1.2. Specific safety measures related to the use of various toxic and hazardous substances would be developed and implemented at each government and contractor facility through a site-specific comprehensive safety plan.

0054.005 Both Figure K-1, Micro Socioeconomic System Approach, and Figure K-2, Program Impact Assessment Model, are generic socioeconomic models and are presented to assist the reader in understanding the basic concepts discussed. It is not possible or appropriate at the programmatic level to apply these models to either the United States or any other country.

0054.006 The impact of the 1994 congressional elections on the BMD Program is not within the scope of this PEIS.

0054.007 The BMD Program is currently not working on any classified technologies that would negate the findings of this PEIS. There are technology programs for nuclear applications and directed energy and other research projects that may require future analysis. These research projects are not part of the BMD Preferred Action or any of the System Acquisition Alternatives. See Section 2.6 for alternatives considered but not carried forward for future analysis in this PEIS.

0054.008 Executive Order 12114 contains provisions for conducting environmental analyses of U.S. actions that take place in either global commons or in foreign territory, when applicable. Numerous analyses have been completed under this authority. Analysis of the BMDO operations have been analyzed for USAKA based on a specific international agreement with the government of the Republic of the Marshall Islands. While all of these documents are site specific, there is no precedent to prepare a PEIS outside the United States.

0054.009 No comments were received from any elected officials. However, had any statements been received, they would have been provided in Chapter 8 of the PEIS and made part of the administrative record.

0057.001 Comment noted.

0058.001 Comment noted.

0060.001 Comment noted.

0061.001 The term "non-degradation" is not used to describe regulations aimed at preventing the decline of existing air quality. The EPA-accepted terminology is "prevention of significant deterioration" regulations. This terminology is introduced in the existing document. The text has been modified to reflect the comment.

0061.002 Under certain conditions, the use of the day/night sound level meters may not adequately address noise impacts from high noise level activities such as aircraft overflights and rocket launches. The Federal Interagency Committee on Noise has agreed that supplemental noise analysis using a single event noise meters such as sound exposure level may be appropriate for assessing noise impacts at specific noise-sensitive locations, particularly speech interference and sleep disturbance. It is recognized that within the range of conditions discussed in Section 3.5.4, there are variations in land use and noise level. In the preparation of further environmental documentation for specific activities, BMDO will consider the use of supplemental noise meters.

0061.003 Potential impacts to surface water resources that could degrade surface water quality under the Preferred Action and the System Acquisition Alternatives are presented in Section 4.7 of the PEIS. Mitigation measures to minimize impacts are also described in Section 4.7. The assessment of impacts on specific surface waters which are protected by applicable state water quality standards from degradation is not within the scope of this PEIS. Such impacts would be addressed in appropriate site-specific environmental documentation, should the NMD system enter the DoD System Acquisition process in the future.

0061.004 Potential activities, accidents, and other events under the Preferred Action and the System Acquisition Alternatives that could present a fire hazard are presented in Section 4.6 of the PEIS. Mitigation measures to minimize impacts are also described in Section 4.6. The assessment of the fire hazard to specific localities or geographic regions is not within the scope of this PEIS. Fire hazards would be addressed in appropriate site-specific environmental documentation, should the NMD system enter the DoD System Acquisition process in the future.

0061.005 Aerial tests associated with the Preferred Action or any of the System Acquisition Alternatives would take place at existing facilities where Special Use Airspace (SUA) has already been designated. The designation of SUA in connection with

deployment of a NMD system will be addressed in future site-specific environmental analyses or would be obtained prior to use.

0063.001 Comment noted.

0063.002 All surveys and studies required under Section 106 of the National Historic Preservation Act and other statutes would be performed under consultation with the various State Historic Preservation Officers before the siting of any BMD activities. Should these measures reveal the potential for adverse impacts to historic and/or cultural resources resulting from BMD activities, all practicable efforts would be made to relocate or redesign the activity to avoid these impacts.

0063.003 Site-specific NEPA documentation, which would include assessments of the potential environmental impacts resulting from BMD Program activities and of the BMD Program's consistency with state and local management programs, would be required once specific locations for BMD activities were determined. Consultations with appropriate coastal zone management agencies would occur as part of this process.

0064.001 Comment noted.

0067.001 Text has been modified to incorporate the recommended change.

0067.002 Text has been modified to incorporate the recommended changes.

0067.003 Text has been modified to incorporate the recommended change.

0067.004 The last paragraph of Section 2.7.1 has been modified to indicate that falling debris would "generally" not be expected to cause water quality impacts and that range recovery procedures would be instituted to prevent secondary impacts to vegetation and wildlife. See response 0067.016 for additional mitigation measures to protect wildlife, including coordinating debris recovery following launches with natural resource agencies where sensitive habitats are involved. The last paragraph of Section 4.7.1.2 addresses mitigation measures related to rocket debris. Appropriate agencies would be consulted during the preparation of recovery plans to mitigate the chance of harm to sensitive species.

0067.005 Text has been modified to incorporate the recommended change.

0067.006 Text has been modified to incorporate the recommended change.

0067.007 Mention of the Bald and Golden Eagle Protection Act has been added to Section 3.11.1 of the PEIS. This and several other wildlife protection acts are also mentioned in Appendix G.

0067.008 Text has been modified to incorporate the recommended change.

0067.009 Text has been modified to incorporate the recommended change.

0067.010 Text has been modified to incorporate the recommended change.

0067.011 Text has been modified to incorporate the recommended change.

0067.012 Specific mitigation measures will be set forth in site-specific NEPA documentation tiered from this PEIS. Before such mitigation measures can be defined, data will be required on site location, site resources, and engineering plans. Thus, mitigation measures presented in the PEIS are those which could be used, but not necessarily those which would be implemented.

0067.013 Text has been modified to incorporate the recommended change.

0067.014 The subject testing activities do not involve low-level flights of missiles that could cause noise impacts to natural resources in canyons. The rocket launches would take place from existing launch facilities (e.g., USAKA, White Sands, VAFB, and Cape Canaveral). Noise impacts for current launch activities have been considered not to be significant. Any new test facilities will be evaluated for noise impacts in appropriate environmental documentation.

0067.015 Examples of behavioral and physiological effects of noise have been included in Section 4.11.1.1.

0067.016 Section 4.11.1.2 has been modified to include additional measures that could be used to mitigate impacts to wildlife and wildlife habitat.

0067.017 Text has been modified to incorporate the recommended change.

0071.001 Comment noted.

Chapter 8 References

NASA, see National Aeronautics and Space Administration.

National Aeronautics and Space Administration, 1978. *Final Environmental Impact Statement for the Space Shuttle Program*, Washington, D.C., April.

The Aerospace Corporation, 1993. *Stratospheric Ozone-Depleting Chemicals Generated by Space Launches Worldwide*, (Aerospace Report TOR-93(3231)-3), prepared for the Space and Missile Systems Center, Air Force Material Command, Los Angeles Air Force Base, California, July.

USASSDC, see U.S. Army Space and Strategic Defense Command.

1U.S. Army Space and Strategic Defense Command, 1993. *Final Environmental Impact Statement for the Restrictive Easement, Kauai, Hawaii*, October.

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Appendix A

APPENDIX A

ABBREVIATIONS AND ACRONYMS

APPENDIX A

ABBREVIATIONS AND ACRONYMS

A.D.	Anno Domini
ABM	Anti-Ballistic Missile
AFB	Air Force Base
AFCCC	Air Force Component Command Center
AFSPACECOM	Air Force Space Command
AIRFA	American Indian Religious Freedom Act
AM	Amplitude Modulation
ANSI	American National Standards Institute
ARCCC	Army Component Command Centers
AV	Air Vehicle
B.C.	Before Christ
BM/C3	Battle Management/Command, Control, and Communications
BMD	Ballistic Missile Defense
BMDO	Ballistic Missile Defense Organization
BMDOC	BMD Operations Center
BMEWS	Ballistic Missile Early Warning System
BSTS	Boost Surveillance and Tracking System
BV	Boost Vehicle
C3I	Command, Control, Communications, and Intelligence
CAA	Clean Air Act of 1970
CAAA	Clean Air Act Amendments of 1990
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
ClF_6/MMH	Chlorine Pentafluoride Monomethyl Hydrazine
CMSA	Consolidated Metropolitan Statistical Area
CONUS	Continental United States
CWA	Clean Water Act
DEM/VAL	Test-proven Demonstration and Validation
DEW	Directed Energy Weapons
DNL	Day/Night Sound Level
DF_2	Deuterium Fluoride
DoD	Department of Defense
D&T	Development and Testing
EA	Environmental Assessment
ECAC	Electromagnetic Capability Analysis Center
EED	Electroexplosive Device
EHF	Extremely High Frequency
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
ELF	Extremely Low Frequency
EMD	Engineering and Manufacturing Development
EMF	Electromagnetic Field
EMR	Electromagnetic Radiation

EOC	Element Operations Center
EPCRA	Emergency Planning and Community Right-to-Know Act
ERIS	Exoatmospheric Reentry Vehicle Interceptor Subsystem
ESA	Endangered Species Act
FDA	Food and Drug Administration
FHBM	Flood Hazard Boundary Map
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FIRM	Flood Insurance Rate Map
FM	Frequency Modulation
FPPA	Farmland Protection Policy Act
FY	Fiscal Year
GB/SB	Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors
GBI	Ground-Based Interceptor
GBR	Ground-Based Radar
GBS	Ground-Based Sensor
GEO	Geosynchronous Earth Orbit
GEP	Ground Entry Point
GLS	Ground-Launched Sensor
GPALS	Global Protection Against Limited Strikes
GSTS	Ground Surveillance and Tracking System
HAP	Hazardous Air Pollutant
HIRF	High Intensity Radar Field(s)
HMTA	Hazardous Materials Transportation Act
HPE	High Power Effects
ICBM	Intercontinental Ballistic Missile
IEEE	Institute of Electrical and Electronics Engineers
IFTU	In-Flight Target Update
IMU	Inertial Measurement Unit
IRS	Inertial Reference System
KV	Kill Vehicle
L	Maximum Antenna Dimension
LADAR	Laser Detection and Ranging
LED	Light Emitting Diode
LWIR	Long-Wavelength Infrared
MACT	Maximum Achievable Control Technology
MCL	Maximum Contaminant Level
MDA	Missile Defense Act
MPE	Maximum Permissible Exposure
MSA	Metropolitan Statistical Area
MTCR	Missile Technology Control Regime
NAAQS	National Ambient Air Quality Standards
NADB	National Archaeological Data Base
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NCA	Noise Control Act
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NMD	National Missile Defense
NMFS	National Marine Fisheries Service
NOHD	Nominal Ocular Hazard Distance

NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTIA	National Telecommunications and Information Administration
NWI	National Wetland Inventory
ODS	Ozone Depleting Substances
OSD	Office of the Secretary of Defense
OSH Act	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
OT&E	Operational Test and Evaluation
P3I	Preplanned Product Improvements
PA	Preferred Action
PATRIOT	Phased Array Tracking to Intercept of Target
PAWS	Phased-Array Warning System
PCAD	Products of Combustion/Atmospheric Dispersion
PCB	Polychlorinated Biphenyl
PEIS	Programmatic Environmental Impact Statement
PM_{10}	Particulate Matter of Less Than 10 Microns in Diameter
POTWs	Publicly Owned Treatment Works
PSD	Prevention of Significant Deterioration
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
ROA	Region of Analysis
ROC	Regional Operations Center
ROD	Record of Decision
ROI	Region of Influence
RS	Readiness Station
SALT	Strategic Arms Limitation Talks
SAR	Specific Absorption Rate
SBI	Space-Based Interceptor
SBS	Space-Based Sensor
SCN	Space Communications Network
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SDWA	Safe Drinking Water Act
SEL	Sound Exposure Level
SHPO	State Historic Preservation Office(r)
SI	International System of Measurement
SIP	State Implementation Plan
SLV	Space Launch Vehicle
SPCC	Spill Prevention Control and Countermeasures
SSTS	Space-Based Surveillance and Tracking System
STARS	Strategic Target System
STORET	Storage and Retrieval for Water Quality Data [Environmental Protection Agency Databank]
T&E	Test and Evaluation
TCN	Terrestrial Communications Network
TMD	Theater Missile Defense
TOM	Target Object Map
TSCA	Toxic Substances Control Act
U.S. COE	U.S. Army Corps of Engineers
U.S. DOI	U.S. Department of the Interior

U.S. DOT	U.S. Department of Transportation
U.S. EPA	U.S. Environmental Protection Agency
U.S. FWS	U.S. Fish and Wildlife Service
U.S. SCS	U.S. Soil Conservation Service
UEWR	Upgraded Early Warning Radar
UHF	Ultra High Frequency
USAF	U.S. Air Force
USAKA	U.S. Army Kwajalein Atoll
USASSDC	U.S. Army Space and Strategic Defense Command
USC	U.S. Code
USCINCSPACE	Commander-in-Chief, United States Space Command
USGS	U.S. Geological Survey
USSPACECOM	U.S. Space Command
USSR	Union of Soviet Socialist Republics
VAFB	Vandenberg Air Force Base
VOC	Volatile Organic Compound
WSMR	White Sands Missile Range

UNITS OF MEASURE

λ	Wavelength
A/cm	Ampere(s) per Centimeter
A/m	Ampere(s) per Meter
BGD	Billions of Gallons per Day
BLD	Billions of Liters per Day
°C	Degree(s) Centigrade
dB	Decibel
dBA	Decibel A-weighted
GHz	Gigahertz
Hz	Hertz
kHz	Kilohertz
km	Kilometer
kV	Kilovolt
kW	Kilowatt
MGD	Million Gallons per Day
mg/L	Milligram(s) per Liter
MHz	Megahertz
mW/cm^2	Milliwatt(s) per Square Centimeter
MW	Megawatt
T	Tesla
V/m	Volt(s) per Meter
W/kg	Watt(s) per Kilogram
W/m^2	Watt per Square Meter
Wb/m^2	Weber per Square Meter

Appendix B

APPENDIX B

GLOSSARY

APPENDIX B

GLOSSARY

Absorption - The process by which the number and energy of particles or photons entering a body of matter are reduced by interaction with the matter.

Accelerometer - An instrument which measures acceleration or gravitational force capable of imparting acceleration.

Acid Rain - Rain with emissions such as sulfur dioxide which can acidify lakes, streams, and even groundwater.

Active Sensor - One that illuminates a target, producing return secondary radiation, which is then detected to track and/or identify the target.

Active Sensor - A sensor for tracking and/or identification purposes that detects a target by emitting EMR and detecting that reflected EMR from a target.

Adsorption - The assimilation of gas, vapor, or dissolved matter by the surface of a solid.

Air Force Space Command (AFSPACECOM) - A major Air Force command and the Air Force component of the United States Space Command responsible for training, equipping, manning, administering, and funding assigned systems.

Air Vehicle (AV) - A sensor payload on top of a booster.

Algal Bloom - A heavy growth of algae in and on a body of water as a result of high phosphate concentration from farm fertilizers and detergents.

Ambient - The environment as it exists around people, plants, and structures.

Antenna Armature - Receiving and transmitting area of an antenna.

Antenna Gain Factor - The ratio of the maximum field strength of an antenna to the field strength that would be radiated from an omnidirectional (lossless, isotropic) antenna fed with the same input power.

Anthropogenic - Relating to or resulting from the influence of human beings.

Anti-Ballistic Missile (ABM) - The term used for Ballistic Missile Defense weapons developed to counter the ballistic missile threat in the late 1960s and early 1970s.

Aquifer - A water-bearing rock, rock formation, or group of formations.

Asbestos - Either of two incombustible, chemical-resistant fibrous mineral forms of impure magnesium silicate, used for fireproofing, electrical insulation, building materials, brake linings, and chemical filters. Asbestos is a carcinogenic substance.

Atmospheric Contaminants - Pollutants in the atmosphere.

Atoll - A ringlike coral island and reef that nearly or entirely encloses a lagoon.

Attack Assessment - An evaluation of information to determine the potential or actual nature and objectives of an attack for the purpose of providing information for timely decisions.

Attainment Areas - Regions that meet the National Ambient Air Quality Standards for a criteria pollutant under the Clean Air Act.

Attenuation - A reduction in strength, force, value, or amount; a weakening.

Altitude - The position of a body as determined by the inclination of the axes to some frame of reference. If not otherwise specified, this frame of reference is fixed to the earth.

Avionics - The design and production of airborne electrical and electronic devices.

Ballistic Missile Defense (BMD) - All active and passive measures designed to detect, identify, track, and defeat attacking ballistic missiles (and entities), in both strategic and theater tactical roles, during any portion of their flight trajectory (boost, post-boost, midcourse, or terminal), or to nullify or reduce the effectiveness of such attacks.

Ballistic Missile Defense Organization (BMDO) - An agency of the Department of Defense whose mission is to manage and direct the conduct of research programs examining the feasibility of eliminating the threat posed by nuclear ballistic missiles of all ranges and of increasing the contribution of defensive systems to United States and Allied security.

Ballistic Missile Early Warning Systems (BMEWS) - Provides tactical warning of ballistic missile attacks, and is part of SPACETRACK system. A two-faced phased array radar located at Thule AB, Greenland; three detection radars and one tracking radar at Clear AFS, AK; and three tracking radars at RAF Fylingdales, UK.

Base Floodplain - Area subject to a 1 percent or greater chance of flooding in any given year (also termed the 100-year floodplain).

Baseline Conditions - The natural and human environmental conditions which are present prior to implementation of a program and against which impacts are assessed.

Battle Management - A task comprised of two parts: (1) evaluating and choosing strategies, and (2) collecting tasks to be performed to successfully implement the chosen strategies.

Battle Management/Command Control, and Communications Element (BM/C3) - Procedures and technologies supporting battle management, command and control, and communications requirements.

Benzene - A clear, colorless, highly refractive, flammable liquid, derived from petroleum and used in or to manufacture a wide variety of chemical products including DDT, detergents, insecticides, and motor fuels.

Beryllium - A high-melting, lightweight, corrosion-resistant, rigid, steel-gray metallic element used as an aerospace structural material, as a moderator and reflector in nuclear reactors, and in copper alloy used for springs, electrical contacts, and nonsparking tools.

Bioaccumulation - Process by which certain pollutants can become incorporated into the tissues of biota and passed up the food chain to predators.

Biodiversity - A term encompassing the variety and genetic variability of species and the variety of the ecosystems they inhabit.

Biological Weapon - An item of material which projects, disperses, or disseminates a biological agent.

Biome - A community of living organisms of a single major ecological region.

BMD Operations Center (BMDOC) - The portion of the Consolidated Command Center providing operations support to Force Direction activities against (nuclear) ballistic missile attacks. The BMDOC collects global operational and Strategic Defense System force readiness status and executes centralized command directives, including weapon release, pre-planned response options, and operational readiness conditions directives.

Boost Phase - The powered flight portion of a ballistic missile or space vehicle trajectory from launch to termination of thrust of the final stage.

Booster - An auxiliary or initial propulsion system which travels with a missile or aircraft and which may or may not separate from the parent craft when its impulse has been delivered. A booster system may contain or consist of one or more units.

Brackish - Containing some salt; briny.

Brilliant Eyes - Space-based sensor element responsible for providing data during post-boost and midcourse phases.

Candidate Species - Category 1 or 2 plant or animal species considered for listing as endangered or threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act.

Carbon Monoxide (CO) - A colorless, odorless, highly poisonous gas formed by the incomplete combustion of carbon or any carbonaceous material, including gasoline. One of six pollutants for which there is a national ambient standard.

Carcinogens - Cancer-causing substances.

Category 1 (Plants and Animals) - Candidate plant and animal species listed under the Endangered Species Act for which the U.S. Fish and Wildlife Service currently has substantial information on hand to support the biological appropriateness of proposing to list them as endangered or threatened.

Category 2 (Plants and Animals) - Candidate plant and animal species listed under the Endangered Species Act for which the U.S. Fish and Wildlife Service possesses information that proposes to list them as endangered or threatened, but for which conclusive data on biological vulnerability and threatenedness are not currently available to support proposed inclusion.

Certification Round - Practice firings of interceptors and/or other missile components to verify system operation under field conditions.

Climax Vegetation - A plant association which has reached its full development and is likely to remain stable unless disturbed by climatic or other environmental changes.

Command and Control System - The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned.

Command, Control, Communications, and Intelligence (C3I) - Procedures and technologies supporting command and control, communication, and intelligence requirements, including those interfaces affecting systems external to the Strategic Defense System.

Command Launch Equipment - An assembly of supporting hardware, software, and technical data that will provide for the readiness, launch operations, and supportability of the ground-based interceptor.

Consolidated Command Center - A term that is projected to define the combination of direct USCINSPACE support staff elements in corresponding operations centers collocated at the Cheyenne Mountain complex during the time of SDS deployment. The Consolidated Command Center is currently in a definition phase at USSPACECOM.

Continental United States (CONUS) - U.S. territory, including the adjacent territorial waters, located within the North American Continent between Canada and Mexico.

Controlled Environment - Area where entry into the radiation hazard area is controlled.

Corrosivity - The tendency of one metal to wear away another by chemical attack.

Criteria Pollutants - The Clean Air Act of 1970 required the U.S. EPA to set air quality standards for common and widespread pollutants after preparing "criteria documents" summarizing scientific knowledge on their health effects. Today there are standards in effect for six "criteria pollutants": ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), lead (Pb), nitrogen dioxide (NO_2), and particulate matter less than 10 micrometers in diameter (PM_{10}).

Critical Action Floodplain - Area subject to a 0.2–1.0 percent chance of flooding in any given year (also termed the 500-year floodplain).

Critical Aquifer Protection Area - Area designated for protection under the Safe Drinking Water Act because of its importance to an aquifer (groundwater source) that serves as a key water supply to a community.

Crossover Region - The area between near-field and far-field electromagnetic radiation.

Cryocooler - Very low temperature cooling units.

Cryogenics - The study of very low temperatures.

Cumulative Impact - The combined impact resulting from all activities occurring concurrently at a given location.

Day/Night Sound Level (DNL) - U.S. EPA noise descriptor indicating the average of sound energy levels throughout the 24-hour day. The 24-hour average-energy sound level is expressed in decibels, with a 10-decibel penalty added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during night hours.

dBA - A measure of noise by a logarithmic conversion of air pressure level variations from Pascal to a unit of measure with a more convenient numbering system compensated by an "A"-weighted filter which accounts for the limited hearing response characteristics of the upper and lower frequency bands of humans.

Decibel (dB) - A unit of measurement on a logarithmic scale which describes the magnitude of a particular quantity of sound pressure or power with respect to a standard reference value.

Decommissioning - The removal from service or the rendering useless of obsolete or no longer needed components.

Decoy - A nonlethal object designed to look like a reentry vehicle to defensive sensors.

Deluge Water - Water released at the time of a rocket launch to provide cooling and acoustic damping.

Demonstration and Validation (DEM/VAL) - DEM/VAL projects are intended to develop confidence for a decision to proceed with full-scale development.

Desalination - The extraction of salt from water or soil.

Directed Energy Weapon (DEW) - A weapon which employs a tightly focused and precisely directed beam of very intensive energy, either in the form of light (a laser) or in the form of atomic particles traveling at velocities at or close to the speed of light (a particle beam weapon).

Dissolution - The act or process of dissolving or of separating into component parts.

Dissolved Solids - A general indicator of contamination by inorganic materials.

Duty Cycle - The product of the pulse duration and pulse frequency of a pulse carrier, equal to the time per second that pulse power is applied.

Effluent Plume - The pathway of movement of effluents through surface water or air.

Electromagnetic Field (EMF) - An electric or magnetic field or combination of the two, as in an electromagnetic wave. Created by electric charges in motion, having both electric and magnetic components oriented at right angles to one another and containing a definite amount of energy.

Electromagnetic Interference - Interference, generally at radio frequencies, that is generated inside systems, as contrasted to radio frequency interference coming from sources outside the system.

Electromagnetic Radiation (EMR) - A series of waves propagated by simultaneous periodic variations of electric and magnetic field intensity.

Electromagnetic Spectrum - The entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves, including visible light.

Element Operations Center (EOC) - A proposed Air Force operations center which operates and maintains a BMD weapon or sensor constellation.

Emission - A release of a pollutant.

Endangered Species - Species of plants and animals that are threatened with either extinction or depletion below sustainable levels in an area and are formally listed by the U.S. Fish and Wildlife Service as endangered.

Endoatmospheric - Within the earth's atmosphere; generally considered to be altitudes below 100 kilometers (62.5 miles).

Engineering, Manufacturing Development - A phase during which the user or users interact with the program office in order to develop product specifications and refine the system being developed.

Entrainment - The process whereby weak-swimming organisms that are small enough to pass through the mesh of an intake screen are carried by the intake current into the intake pipeline.

Environmental Assessment/Environmental Impact Statement (EA/EIS) - An EA is a publication that provides sufficient evidence and analysis to show whether a proposed system will adversely affect the environment or be environmentally controversial. If the proposed system will adversely affect the environment or be controversial, an EIS is prepared.

Estuaries - Coastal water bodies that are mixing zones for freshwater and saltwater, within which water quantity and salinity change with the ebb and flow of the tides.

Etchant - An acid used to treat metal or glass by corrosive action.

Eutrophication - A state of increased biotic productivity resulting from the introduction of large quantities of inorganic plant nutrients (particularly nitrogen and phosphorus) into a body of water.

Exoatmospheric - Outside the earth's atmosphere; generally considered to be altitudes above 100 kilometers (62.5 miles).

Exoatmospheric Reentry Vehicle Interceptor Subsystem - A ground-based, non-nuclear, hit-to-kill interceptor designed to provide functional test validation of GBI.

Explosive Safety Quantity Distance - The quantity of explosive material and distance separation relationships providing defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures.

Extirpate - To destroy completely.

Extremely Low Frequency (ELF) - A frequency below 300 Hertz in the radio spectrum.

Far Field - The region far from an antenna compared to the dimensions of the antenna and the wavelength of the radiation.

Fauna - Animal life, especially the animal characteristics of a region, period, or special environment.

Field of View - The angular measure of the volume of space within which the system can respond to the presence of a target.

Floodplain - Lowland area adjoining inland or coastal waters subject to a specified chance of flooding in any given year. Typically defined either as the base floodplain, subject to a 1 percent or greater chance of flooding in a given year, or as the critical action floodplain, subject to a 0.2–1.0 percent chance of flooding in a given year.

Floodway - That portion of the base floodplain that must be kept free of encroachment to discharge the 100-year flood without increasing the height of the floodwater by more than 30.5 centimeters (1.0 foot).

Floodway Fringe - That part of the base floodplain that is not within the floodway.

Flora - Vegetation; plant life characteristic of a region, period, or special environment.

Flyway - An established route of migratory birds.

Focal Plane Array - A matrix of photon-sensitive detectors which, when combined with low-noise preamplifiers, provides image data for the signal frequencies of interest.

Follow-on Technologies - Research and development efforts which can upgrade or improve system capabilities beyond elements in the Proposed Action.

Forb - A broadleaved nonwoody plant.

Free-Field Conditions - Conditions under which there are no reflections or attenuations of sound other than atmospheric attenuations.

Freshwater Lense - Shallow aquifer which overlies saline groundwater.

Gamma Rays - A range of electromagnetic radiation wavelengths shorter than X-ray wavelengths.

Geosynchronous Earth Orbit - High altitude Earth orbits in which a satellite rotates with Earth's spin period, thus appearing stationary with respect to its sub-Earth point.

Gigahertz (GHz) - An electromagnetic wave frequency of 1 billion waves per second.

Global Climate Change - Alternations in the energy balance of the earth's atmosphere resulting from the burning of fossil fuels.

Global Protection Against Limited Strike (GPALS) - Title of an SDI architecture and function which protects against a limited number of accidental or unauthorized ICBM, SLBM, or tactical ballistic missile attacks. GPALS is known as Global Missile Defense (GMD).

Greenhouse Effect - The phenomenon in which the sun's energy, in the form of light waves, passes through the air and is absorbed by the earth, which then radiates the energy as heat waves that the air is able to absorb. The air thus behaves like glass in a greenhouse, allowing the passage of light but not of heat.

Greenhouse Gases - Atmospheric gases (principally carbon dioxide, water vapor, nitrous oxide, chlorofluorocarbons, and methane) which absorb infrared radiation and contribute to the "greenhouse effect."

Ground Entry Point (GEP) - An antenna, pedestal, and associated electronic equipment mounted within a radome. The GEP would receive and process data from a command center and would communicate with interceptors and other elements.

Ground Hazard Area - The area in which dangerous debris could fall during a launch.

Ground-Based Interceptor (GBI) - Interceptor designed to engage reentry vehicles in the exoatmosphere during midcourse.

Ground-Based Radar (GBR) - An active sensor system which is able to detect and track objects by transmitting a beam of electromagnetic energy and detecting the reflections of this energy off the object.

Ground-Based Sensor (GBS) - Ground-based element which would perform incoming missile detection, identification/discrimination, and tracking functions.

Ground Surveillance and Tracking System (GSTS) - See Ground-Launched Sensor.

Ground-Launched Sensor (GLS) - A fast-response rocket-launched sensor which can support the SDS midcourse sensor suite by employing multiple long wave infrared (LWRI) wavebands and a visible waveband sensor to provide tracking and discrimination of potentially lethal targets. Formerly/previously GSTS.

Ground-Level Ozone - Ozone produced near the surface of the earth primarily by fossil fuel burning. Environmental and health concerns are associated with higher concentrations of ozone at ground level.

Groundwater - Freshwater found beneath the earth's surface, usually in aquifers, which supplies wells and springs.

Halogen - Any of the elements of the halogen family, consisting of fluorine, chlorine, bromine, iodine, and astatine.

Hardening - Measures which may be employed to render military assets less vulnerable.

Hazardous Air Pollutants (HAPs) - Any of the 189 air pollutants, identified in the Clean Air Act Amendments of 1991, which could have an adverse health or environmental impact.

Hazardous Material - Generally, a substance or mixture of substances that has the capability of either causing or significantly contributing to an increase in mortality or an increase in irreversible or incapacitating reversible illness; or posing a substantial present or potential risk to human health or the environment. Use of these materials is regulated by the U.S. Department of Transportation (DOT), the Occupational Safety and Health Administration (OSHA), and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

Hazardous Substances - Elements, compounds, mixtures, and complex materials which have explosive, flammable or ignitable, corrosive, or reactive properties.

Hazardous Waste - A waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either cause or significantly contribute to an increase in mortality or serious irreversible illness or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Regulated under the Resource Conservation and Recovery Act (RCRA).

Heavy Metals - Metallic or semimetallic elements of high molecular weight, such as mercury, chromium, cadmium, lead, and arsenic, that are toxic to plants and animals at known concentrations.

Hydrazine - A colorless liquid with an ammonia-like odor; used as a rocket fuel and in the synthesis of biologically active materials, explosives, antioxidants, and photographic materials.

Hydrocarbon - Any of a vast family of compounds containing hydrogen and carbon. Used loosely to include many organic compounds in various combinations; most fossil fuels are composed predominantly of hydrocarbons. When hydrocarbons mix with nitrogen oxides in the presence of sunlight, ozone is formed.

Impingement - The process by which aquatic organisms too large to pass through the screens of a water intake system become caught on the screens and are unable to escape.

In-Flight Target Updates (IFTU) - 3D state vector of a target which is used by an interceptor for guidance to a target after launch and prior to terminal homing.

Inertial Measurement Unit (IMU) - A guidance mechanism designed to project a missile over a predetermined path, wherein the path of the missile is adjusted after launching by devices wholly within the missile and independent of outside information. The unit measures and converts accelerations experienced to distance traveled in a certain direction.

Infrared - A range of electromagnetic radiation wavelengths longer than visible light and shorter than microwave wavelengths.

Infrastructure - Facilities, utilities and other entities of the physical plant which support military, civil, and commercial space operations.

In-migrant - A person who moves into an area.

Intercontinental Ballistic Missile (ICBM) - A ballistic missile with a range of 3,000 to 8,000 nautical miles. The term ICBM is used only for land-based systems, to differentiate them from submarine-launched ballistic missiles.

Integration - The process of merging key flight-ready elements (made of pre-assembled components) of a system into a functional, final product.

Inverse Square Law - The law in which a physical quantity varies with distance from a source inversely as the square of that distance.

Karst - A type of topography that is formed over limestone, dolomite, or gypsum by dissolving or solution, and that is characterized by closed depressions or sinkholes, caves, and underground drainage.

Kill Vehicle (KV)/Kinetic Kill Vehicle (KKV) - A weapon using a non-explosive projectile moving at very high speed to destroy a target on impact. The projectile may include homing sensors and on-board rockets to improve its accuracy, or it may follow a preset trajectory.

LADAR - Laser detection and ranging. A technique analogous to radar, but which uses laser light rather than radio or microwaves.

Laser - An active electron device that converts input power into a very narrow, intense beam of coherent visible or infrared light; the input power excites the atoms of an optical resonator to a higher energy level, and the resonator forces the excited atoms to radiate in phase. Derived from light amplification by stimulated emission of radiation and classified from Class I - Class IV according to its potential for causing damage to the eye.

Launch Exhaust Cloud - The exhaust cloud resulting from rocket launches; a potential contributor to aerial contamination of nearby surface waters.

Launch Safety Zone - A limited-access water and shore area controlled by the U.S. Coast Guard when necessary for the protection of any vessel, structure, water, and shore area from a launch safety hazard.

Launch Silo - An underground launch facility, with power generation equipment including generator/batteries, power distribution, and fuel storage, environmental control, and intrusion and prevention equipment.

Lead (Pb) - A heavy metal which can accumulate in the body and cause a variety of harmful effects. One of six pollutants for which there is a national ambient air quality standard.

Life Cycle - The chronological phases of a system's or program's life, including the test and evaluation, basing, maintenance, and decommissioning phases.

Limited Defense System - A defense system using ground-based interceptors supported by both ground-based radars and space-based sensors.

Long Waveband Infrared (LWIR) - Thermal radiation emitted by a source in the electromagnetic spectrum encompassing infrared wavelength of 6 to 30 microns.

Main Beam - The primary directional EMR emitted from radar transmitters.

Maximum Achievable Control Technologies (MACTs) - Technologies determined by U.S. EPA for toxic air pollutants which will achieve the maximum emission reduction, taking into account cost, energy requirements, and non-air quality health and environmental impacts.

Megahertz (MHz) - An electromagnetic wave frequency at 1 million waves per second.

Methane (CH_4) - A colorless, odorless, flammable, gaseous hydrocarbon that is a product of decomposition of organic matter and the burning of fossil fuels.

Metropolitan Statistical Area (MSA) - An area with a city of at least 50,000 in population, or an urbanized area of at least 50,000 with a total metropolitan population of at least 100,000.

Microbe - A microorganism, especially a bacterium of a pathogenic nature.

Mitigation - A method or action to reduce or eliminate program impacts.

Mutagen - An agent such as various gases or radiation that tends to increase the frequency or extent of mutations.

National Ambient Air Quality Standards (NAAQS) - Nationwide standards set up by the U.S. EPA for widespread air pollutants, as required by Section 109 of the Clean Air Act. Currently, six pollutants are regulated by primary and secondary NAAQS: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10}), and sulfur dioxide (SO_2).

National Register of Historical Places - A register of districts, sites, buildings, structures, and objects important in American history, architecture, and culture, maintained by the Secretary of the Interior under authority of Section 2(b) of the Historic Sites Act of 1935 and Section 101(a)(1) of the National Historic Preservation Act of 1966, as amended.

National Test Facility - The principal portion of the NTB at Falcon AFB, Colorado.

Native American Lands - Used in a collective sense to refer to land inhabited by individuals, bands, or tribes who trace their ancestry to indigenous populations of North America prior to Euro-American contact.

Near Field - The electromagnetic field that exists within the wavelength of a source of electromagnetic radiation.

Neutral Particle Beam - An energetic beam of neutral particles that is generally used to damage electronics.

Nitrogen Dioxide (NO_2) - Gas formed primarily from atmospheric nitrogen and oxygen when combustion takes place at high temperatures. NO_2 emissions contribute to acid deposition and formation of atmospheric ozone. One of the six pollutants for which there is a national ambient standard.

Nitrogen-fixing - Either the metabolic assimilation of atmospheric nitrogen by soil microorganisms, or the industrial conversion of free nitrogen into combined forms useful as starting materials for fertilizers or explosives.

Nitrogen Tetroxide - An oxidizer used in a dual-propellant propulsion system.

Nitrous Oxide (N_2O) - A colorless gas that when inhaled produces loss of sensibility to pain preceded by exhilaration and sometimes laughter.

Noise Receptors - Receptors which are affected by noise; can include people or wildlife.

Non-ionizing Radiation - Electromagnetic radiation which has a frequency of less than 10^{16} hertz.

Nonattainment Area - An area that has been designated by the U.S. EPA or the appropriate state air quality agency as exceeding one or more national or state ambient air quality standards.

Nonpoint Discharge - The discharge of contaminants in a diffused manner originating from a large area.

Nuclear Weapon - A complete assembly in its intended ultimate configuration which, upon completion of the prescribed arming, fuzing, and firing sequences, is capable of producing the intended nuclear reaction and release of energy.

Operational Test and Evaluation (OT&E) - T&E conducted to estimate a system's military utility, operational effectiveness, and operational suitability, as well as the need for any modifications. It is accomplished by operational and support personnel of the types and qualifications expected to use and maintain the system when deployed, and is conducted in as realistic an operational environment as possible.

Orbiting Debris - Term referring to all earth-orbiting objects except active satellites.

Oxidizer - A substance that supports the combustion of rocket propellant.

Ozone (O_3) - A major ingredient of smog. Ozone is produced from reactions of hydrocarbons and nitrogen oxides in the presence of sunlight and heat. Some 68 areas, mostly metropolitan areas, did not meet a 31 December 1987 deadline in the Clean Air Act for attaining the ambient air quality standard for ozone.

Ozone Layer - A naturally occurring layer of ozone 4.4 kilometers to 18.6 kilometers (7 to 30 miles) in the stratosphere above the earth's surface. The ozone layer filters out the sun's harmful ultraviolet radiation. It is not affected by photochemical smog found in the lower atmosphere. There is no mixing between ozone at ground level and ozone in the upper atmosphere.

Pad - The physical structure portion of a complex that supports the actual launch vehicle during launch processing, countdown, and liftoff.

Particulate Matter of Less Than 10 Micrometers (PM_{10}) - Finely divided solids or liquids less than 10 microns in diameter that, when inhaled, remain lodged in the lungs and contribute to adverse health effects. One of the six pollutants for which there is a national ambient standard.

Passive Sensor - A sensor that detects EMR emissions from a target for tracking and/or identification purposes.

PAVE PAWS - Phased array submarine-launched ballistic missile warning system.

Payload - A load carried by an aircraft, rocket, etc., that consists of anything not essential to its flight operations.

Percolation - The process of passing or oozing through a permeable substance.

Permeability - Having the ability to diffuse through or penetrate something.

Phased Array - The arranging of radiating and/or receiving elements that, although physically stationary, are electronically steerable and can be switched rapidly from one target to another.

Photochemical - A chemical reaction resulting from exposure to radiant energy or light.

Physical Agent - Descriptive term that includes non-ionizing EMR, static electric and magnetic fields, ionizing radiation, energy beams, noise, explosions, deorbiting debris, and extreme cold.

Point Source Discharge - Any discernible confined and discrete conveyance from which pollutants are or may be discharged.

Polychlorinated Biphenyl (PCB) - Any of a family of industrial compounds produced by the chlorination of biphenyl. These compounds are noted chiefly as an environmental pollutant that accumulates in organisms and concentrates in the food chain with resultant pathogenic and teratogenic effects. They also decompose very slowly.

Post-Boost Phase - The period immediately after booster engine burnout; includes that portion of the flight during which the post-boost vehicle releases its reentry vehicle on predetermined trajectories.

Post-Boost Vehicle - The portion of a rocket's payload that carries the multiple warheads and has maneuvering capability to place each warhead on its final trajectory to a target. Also referred to as "bus."

Power Density - A measure of electromagnetic fields.

Prevention of Significant Deterioration (PSD) - Regulations established by the 1977 Clean Air Act Amendments to limit increases in criteria pollutant concentrations above a baseline.

Prime Farmland - Environmentally significant agricultural lands protected from irreversible conversion to other uses.

Pulsed Power EMR - Radiated fields that have very high instantaneous peak field strengths or power density but significantly lower average values.

Pupping - Giving birth.

Radiation Balance - Temperature equilibrium influenced by three factors: sunlight received and reflected by the earth and by the infrared radiation absorbed by the atmosphere (see Global Climare Change).

Radionuclide - Radioactive nuclide (a species of atom characterized by the number of protons and neutrons and the energy content).

Radon - A heavy radioactive gaseous element formed by the disintegration of radium.

Reentry - The return of objects, originally launched from earth, into the atmosphere.

Reentry Vehicle - That part of a space vehicle designed to re-enter the earth's atmosphere in the terminal portion of its trajectory.

Region of Analysis (ROA) - The general locations wherein BMD activities under the Proposed Action and Alternatives would occur and for which environmental settings are characterized; this region encompasses the Continental United States (CONUS), Alaska, Hawaii, U.S. territorial islands, and the Republic of the Marshall Islands.

Region of Influence (ROI) - The area of interest for socioeconomic issues, usually consisting of one or more counties. The ROI includes the area where most of a facility's workers reside as well as where the facility or project is located.

Regional Operations Center (ROC) - A group of fixed and/or mobile centers with Operation Control (OPCON) over allocated ground-based sensors and weapons.

Research and Development System - A capability used to demonstrate or validate new technology but which, as designed, is not intended for use in an operational capacity.

Riparian - Living or being located on the bank of a natural waterway such as a river, lake, or tidewater.

Riverine Floodplain - Valley area adjacent to any size stream or river and subject to flooding.

Salinity - The total quantity of dissolved salts in sea water, measured by weight in parts per thousand.

Saltwater Intrusion - Physical process which occurs when there is an overdraft of fresh groundwater from certain aquifers resulting in saltwater entering the aquifer.

Satellite - A man-made object rocketed into orbit around the earth, moon, etc.

Sedimentation - A process through which material is deposited by wind or water.

Seeker - Short range sensing device in a range up to tens of kilometers.

Seepage - The process of flowing or passing slowly through fine pores or small openings.

Short-Range Attack Missile (SRBM) - A ballistic missile with a range capacity of about 600 nautical miles.

Sidelobes - Residual EMR surrounding the main beam of a phased array radar, which is of weaker power than the main beam.

Sinkhole - A place in which drainage collects.

Smog - A photochemical haze produced when hydrocarbons and nitrogen oxides are in the presence of light.

Soil Horizon - A layer of soil or soil material approximately parallel to the land surface which differs from adjacent layers due to physical, chemical and biological characteristics.

Solid Rocket Motor - Propulsive structure which provides thrust from solid propellant and which is enclosed in a hardware casing.

Sonic Boom - A sound resembling an explosion produced when a shock wave formed at the nose of an airplane traveling at supersonic speed reaches the ground.

Sound Exposure Level (SEL) - A measurement of the intrusiveness of sound, combining sound level and duration.

Space-Based Interceptor (SBI) - An orbiting space platform from which interceptor rockets could be launched at hostile intercontinental or submarine-launched ballistic missiles against an earth background.

Space-Based Sensor (SBS) - A distributed space-based surveillance system designed to perform the boost, post-boost, and midcourse tracking from booster acquisition through the early terminal phase.

Space Vehicle - Any device or contrivance for carrying or conveying persons or objects through or into space.

Spring Tides - A tide cycle of unusually large amplitude that occurs twice monthly when the linear and solar tides are in phase.

Static Fire Tests - Tests of rocket components by stationary on-the-ground ignition. No rocket flight occurs during static fire tests.

Static Firing - See static fire tests.

Steady-State EMR - Electromagnetic radiation which does not vary with time.

Strategic Defense Initiative (SDI) - All research and testing applicable to the development of a strategic defense system.

Strategic Defense System (SDS) - A global integration of ground-, sea-, and space-based sensors, weapons, and C2 elements designed to deter an offensive ballistic missile attack or to counter such an attack should deterrence fail.

Strategic Target System (STARS) - A missile booster system to replace MM I boosters. The new STARS missile is a three-stage solid propellent booster system that uses selected parts of Polaris A3 missiles with a third-stage modification.

Stratosphere - The portion of the atmosphere between altitudes of approximately 10 kilometers (6.2 miles) at the poles or 15 kilometers (9.3 miles) at the equator to 30 kilometers (18.6 miles).

Stratospheric Sulfuric Acid Aerosol - Sulfuric acid gas which was used as a propellant in aerosol cans that has reached the stratosphere.

Submarine-Launched Ballistic Missile - A ballistic missile launched from a submarine, with a range of 4,830 to 9,660 kilometers (3,000 to 6,000 miles).

Sulfur Dioxide (SO_2) - A toxic gas that is produced when fossil fuels, such as coal and oil, are burned. SO_2 is the main pollutant in the formation of acid rain. SO_2 also can irritate the upper respiratory tract and cause lung damage. One of the six pollutants for which there is a national ambient standard.

Suspension - A heterogeneous mixture in which the particles of one substance are kept dispersed by agitation.

Tactical Warning - (1) A warning after initiation of a threatening or hostile act based on an evaluation of information from all available sources. (2) In satellite and missile surveillance, a notification to operational command centers that a specific threat event is occurring. The component elements that describe threat events are: country of origin, event type and size, country under attack, and event time.

Tactical Warning/Attack - A composite term. See separate definitions for Tactical Warning and for Attack Assessment.

Target Object Map (TOM) - The relative or inertial location of targets that are likely to be seen by an interceptor seeker as identified by the sensing system.

Test and Evaluation (T&E) - Process by which components or systems are tested and the results evaluated to assess progress of design, performance, supportability, etc. There are three types of T&E -- Development (DT&E), Operational (OT&E), and Production Acceptance (PAT&E) -- occurring during the acquisition cycle. DT&E is conducted to assist the engineering design and development process and to verify attainment of technical performance.

Theater Missile Defense (TMD) - The strategies and tactics employed to defend a geographical area outside the Continental United States against attack from short-range or medium-range missiles.

Threatened Species - Any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Trajectory - The curve described by an object moving through space.

Topography - The general configuration of a surface, including its relief; may be a land or water-bottom surface.

Toxic Substance - A harmful substance which includes elements, compounds, mixtures, and materials of complex composition.

Toxicity - The kind and amount of poison or toxin produced by a microorganism, or possessed by a chemical substance not of biological origin.

Troposphere - The portion of the atmosphere extending from the earth's surface to 20 kilometers (12.5 miles) above it.

Tsunami - A long-period sea wave produced by a seaquake or volcanic eruption; it may travel for thousands of miles. Also known as a sea wave.

Ultraviolet - A range of electromagnetic radiation wavelengths shorter than visible light and longer than x-ray wavelengths.

Uncontrolled Environment - Area where entry into the radiation hazard is not controlled.

Unique Farmland - Land other than prime farmland that is used for production of specific high-value food and fiber crops.

United States Army Space and Strategic Defense Command (USASSDC) - Serves as Army component of USSPACECOM. Provides matrix support to program executive officer (missile defense). Executes BMDO research and technology missions.

United States Space Command (USSPACECOM) - The unified command responsible for planning and conducting ballistic missile defense.

Upper Atmosphere - That portion of the atmosphere which includes the stratosphere, mesosphere, and thermosphere.

Urbanization - The state of being or becoming a community with urban characteristics.

Vinyl Chloride - A flammable, explosive gas used in organic synthesis and adhesives.

Volatile Organic Compound (VOC) - A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol.

Volatility - The quality of having a low boiling point or subliming temperature at ordinary pressure or, equivalently, of having a high vapor pressure at ordinary temperatures.

Water Balance - Rate at which water enters and leaves a natural or man-made system.

Watershed - The drainage area of a stream or other surface water.

Wavelength - The distance between two points having the same phase in two consecutive cycles of a periodic wave, along a line in the direction of propagation.

Wetlands - Areas that are inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil. This classification includes swamps, marshes, and similar areas.

X-Rays - A range of electromagnetic radiation wavelengths shorter than ultraviolet wavelengths.

Appendix C

APPENDIX C

BALLISITIC MISSILE DEFENSE

MAILING LIST

APPENDIX C

BALLISTIC MISSILE DEFENSE MAILING LIST

This Ballistic Missile Defense (BMD) list includes interested federal, state, and local agencies and individuals who have expressed an interest in receiving BMD Program documents.

ELECTED OFFICIALS

Federal Elected Officials

U.S. House of Representatives

Representative Karen Shepherd

GOVERNMENT OFFICES

BMD PEIS Cooperating Agencies

U.S. Department of Energy/DP-34
Mr. Gary Palmer

National Aeronautics and Space Administration (NASA/JXG)
Mr. Kenneth Kumor

ATMD Program Office
SFAE-MD-TMD
Mr. Warren Martin

CNO OP44EP
Ms. Kim Depaul

Naval Air Warfare Center
Mr. Scott Perry

SMC/CEV
Mr. John Edwards

Department of Agriculture

U.S. Forest Service
Director of Environmental Coordination

Department of Commerce

National Marine Fisheries Service
Ms. Nancy Foster

GOVERNMENT OFFICES (CONTINUED)

Department of Defense

Environment and Safety
Ms. Jenny Trinidad

HQ/AFMC/CE/VC
Wright-Patterson AFB
Ms. Lynn Engleman

HQMC (LFL)
Mr. Tom Coda

Marine Environmental Protection Section
Washington, D.C.

Naval Surface Warfare Center
Dahlgren Laboratory/Code C832

Office of the Assistant Secretary of Defense
Mr. Brian Higgins

Office of Under Secretary of Defense
Mr. Dick Kibler

OSD-JCCD-JTF
Vicksburg, MS
Dr. Victor Lagarde

Strategic System Programs
CM3, SP203

U.S. Army
Mr. Paul Stark

U.S. Army
USASDC-CSSD-EN
Mr. Dru Barrineau

U.S. Army Corps of Engineers
Washington, D.C.

U.S. Army Research Laboratory
AMSRL-SS-F
Love Mann

U.S. Army Test and Evaluation
Aberdeen Proving Grounds
Mr. Nick Cavallaro, Commander

GOVERNMENT OFFICES (CONTINUED)

Department of Energy

EH 231
Ms. Kathleen Schmidt

Federal Energy Regulatory Commission
Environmental Analysis Branch

NEPA Affairs Division
Ms. Carol Borgstrom

Department of Interior

Bureau of Land Management

Federal Activities Branch

Office of Environmental Affairs
(MS 2340)
Dr. Jonathan P. Deason, Director
Ms. Lillian K. Stone, P.E.

National Park Service
Department of Environmental Quality
Mr. John Donahue
Mr. Dick Morlock

U.S. Fish and Wildlife Service
Mr. John Turner

Department of Justice

U.S. Department of Justice

Department of Labor

Occupational Safety and Health Administration
Mr. Gerald Scannell

Department of State

Deputy Assistant Secretary
Environment, Health and Natural Resources, BOIESA

Office of Environment and Health

PM-SNP

GOVERNMENT OFFICES (CONTINUED)

Department of Transportation

Federal Aviation Administration

U.S. Coast Guard

Environmental Protection Agency

Office of Federal Activities
Mr. Terry Haiamizu
Mr. David Powers
Ms. Gwen Whitt
Ms. Ruth Wilkerson

Region 1 Office
U.S. Environmental Protection Agency

Region 2 Office
U.S. Environmental Protection Agency

Region 3 Office
U.S. Environmental Protection Agency

Region 4 Office
U.S. Environmental Protection Agency

Region 5 Office
U.S. Environmental Protection Agency

Region 6 Office
U.S. Environmental Protection Agency

Region 7 Office
U.S. Environmental Protection Agency

Region 8 Office
U.S. Environmental Protection Agency

Region 9 Office
U.S. Environmental Protection Agency

Region 10 Office
U.S. Environmental Protection Agency

Executive Office of the President

Council on Environmental Quality

Office of Management and Budget
Natural Resources Division

GOVERNMENT OFFICES (CONTINUED)

Executive Office of the President (Continued)

Marine Mammal Commission
General Counsel

National Security Council

Office of Science and Technology Policy

Federal Emergency Management Agency

Associate General Counsel

National Preparedness Branch
Region V
Mr. Michael G. Moline

General Accounting Office

Community and Economic Development Division

Interstate Commerce Commission

Office of Transportation Analysis

National Aeronautics and Space Administration

Mr. Martin P. Kress

Mr. J. C. Sawyer

CSFC/WFF
Ms. Pam Whitman, Director

National Science Foundation

Directorate for Geosciences

State Agencies

State of California
California Coastal Commission
Mr. Mark Delaplaine

State of Colorado
Division of Local Government

State of Utah
Governor's Office, Planning and Budget
Mr. Brad T. Barber

GOVERNMENT OFFICES (CONTINUED)

State Agencies (Continued)

State of Hawaii
Office of Hawaiian Affairs
Ms. Lynn Lee

State of Maine
State Planning Office, Executive Department
Ms. Joyce Benson

State of North Carolina
Department of Environment, Health and Natural Resources

State of Ohio
Office of Management and Budget
Ms. Wendy Vorwerk

State of Texas
Office of the State Archaeologist
Mr. Harry W. Clark

REPUBLIC OF THE MARSHALL ISLANDS

Environmental Protection Authority
Mr. Kasuo Helgenberger, General Manager

CLEARINGHOUSES

Alaska State Clearinghouse

Arizona State Clearinghouse

California State Clearinghouse

Colorado State Clearinghouse

Connecticut State Clearinghouse

Delaware State Clearinghouse

Florida State Clearinghouse

Georgia State Clearinghouse

Hawaii State Clearinghouse

Idaho State Clearinghouse

Illinois State Clearinghouse

CLEARINGHOUSES (CONTINUED)

Indiana State Clearinghouse

Iowa State Clearinghouse

Kansas State Clearinghouse

Kentucky State Clearinghouse

Louisiana State Clearinghouse

Maine State Clearinghouse

Maryland State Clearinghouse

Massachusetts State Clearinghouse

Mississippi State Clearinghouse

Missouri State Clearinghouse

Montana State Clearinghouse

Nebraska State Clearinghouse

New Hampshire State Clearinghouse

Nevada State Clearinghouse

New Jersey State Clearinghouse

New York State Clearinghouse

North Carolina State Clearinghouse

North Dakota State Clearinghouse

Ohio State Clearinghouse

Oregon State Clearinghouse

Pennsylvania State Clearinghouse

Rhode Island State Clearinghouse

South Carolina State Clearinghouse

South Dakota State Clearinghouse

Tennessee State Clearinghouse

CLEARINGHOUSES (CONTINUED)

Texas State Clearinghouse

Utah State Clearinghouse

Vermont State Clearinghouse

Virginia State Clearinghouse

Washington State Clearinghouse

Wisconsin State Clearinghouse

Wyoming State Clearinghouse

OTHERS

Organizations

American Rivers
Washington, DC

Concern, Inc.
Washington, DC

Defenders of Wildlife
Washington, DC

Environmental Defense Fund, Inc.
New York, NY

Friends of the Earth
Washington, D.C.

Full Gospel Tabernacle
Bellflower, CA

Greenpeace USA, Inc.
Washington, DC

League of Women Voters of the United States
Washington, DC

National Parks and Conservation Association
Washington, DC

National Resource Council, National Academy of Sciences, National Academy of Engineering, Institute of Medicine
Washington, DC

OTHERS (CONTINUED)

Organizations (Continued)

National Resources Defense Council, Inc.
New York, NY

National Wildlife Federation
Washington, DC

Sierra Club
San Francisco, CA

The Conservation Foundation
Washington, DC

The National Audubon Society
New York, NY

Union of Concerned Scientists
Cambridge, MA

Wilderness Society
Washington, DC

Wildlife Society
Bethesda, MD

Worldwatch Institute
Washington, DC

Zero Population Growth, Inc.
Washington, DC

Other Organizations

Acquisition Planning
Dr. Paul Mizena

ARBS
Mr. Kirk Battleson

Associated Press
Lee Siegel

British Embassy
Mr. Graham Gasston

California Wilderness Coalition
Mr. Jim Eaton

OTHERS (CONTINUED)

Other Organizations (Continued)

Christian Science Monitor Radio
Chris Ballman

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Appendix D

APPENDIX D

NOTICE OF INTENT

APPENDIX D

NOTICE OF INTENT

The following notice of intent was circulated and published by the Department of Defense in the February 4, 1992 *Federal Register* in order to provide public notice of its intent to prepare a Draft Programmatic Environmental Impact Statement (PEIS) for a Ballistic Missile Defense System. This Notice of Intent has been retyped for clarity and legibility.

Intent (NOI) to Prepare a Draft Programmatic Environmental Impact Statement (EIS) for a Ballistic Missile Defense System.

The proposed action is to conduct development and test activities to provide the United States with the capability to produce, deploy, and maintain a missile defense system that will provide a defense against ballistic missile strikes. The system will use a combination of space- and ground-based sensors, interceptors, and communications systems, and a ground-based command and control system.

Alternatives

Alternatives to be evaluated in the Environmental Impact Statement (EIS) include the following: (1) No Action Alternative; (2) All Ground-Based System Alternative; (3) All Spaced-Based System Alternative; (4) Ground- and Space-Based Sensors with Space-Based Interceptors System Alternative; and (5) Ground- and Space-Based Sensors and Ground-Based Interceptors System Alternative.

Under the no action alternative (Alternative 1), no system development and testing would be conducted to provide a global protection against limited ballistic strikes capability. Under Alternative 2, only ground-based sensors and interceptors would be utilized to meet mission objectives. Under Alternative 3, only space-based sensors and interceptors would be utilized to meet mission objectives. Alternatives 4 and 5 represent a mixture of space- and ground-based sensors and interceptors distinct from those of the proposed action. All alternatives with the exception of the no action alternative would involve ground-based command and control.

Background

During his 1991 State of the Union address, President Bush called for the Strategic Defense Initiative (SDI) to be refocused. The new focus involves protecting the United States, our forces overseas, and our friends and allies from limited ballistic missile strikes, regardless of their origin. The Strategic Defense Initiative Organization (SDIO) named this refocused program Global Protection Against Limited Strikes (GPALS).

Congress provided guidance and direction to the Department of Defense in regards to missile defense by enacting the Missile Defense Act of 1991. The Act states: "It is the goal of the United States to: (1) Deploy an anti-ballistic missile system, including one, or an adequate additional

number of anti-ballistic missile sites and space-based sensors, that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles; (2) maintain strategic stability; and (3) provide highly effective theater missile defenses (TMDs) to forward-deployed and expeditionary elements of the Armed Forces of the United States and to friends and allies of the United States."

SDIO is currently evaluating system architecture concepts that consist of a combination of space- and ground-based sensors, ground-based interceptors, and command, control and communication networks. Architecture concepts are also being developed for a follow-on space-based interceptor capability. The system architecture concept integrates theater and strategic missile defenses. Global means protecting the U.S. worldwide interests with theater defenses, as well as defenses for the American homeland. Protection means that the objective is to have an extremely low number or no offensive weapons getting past our defensive system. Limited means that the system can defend against up to 200 attacking ballistic missile warheads in a variety of scenarios. A fully developed GPALS system will provide continuous detection, tracking, and protection against limited strikes by tactical and strategic missiles.

The system is an integration of three segments that are designed to defend against different types or classes of missile threats. The segments are: Theater Missile Defense (TMD), National Missile Defense (NMD), and Global Missile Defense (GMD). The TMD segment is designed to defend against theater missiles. The TMD segment is rapidly relocatable in order to defend U.S. deployed forces and U.S. friends and allies from theater missiles. The NMD segment is designed to defend the Continental United States (CONUS), Alaska, and Hawaii. As proposed, the NMD system consists of ground- and space-based sensors and ground-based interceptors. It will be capable of destroying individual warheads in the late terminal phase of flight. The GMD segment is envisioned to be a subsequent development and will consist of space-based interceptors capable of destroying missiles in all phases of flight. All segments of the system will be integrated with a Battle Management Command, Control and Communications (BM/C3) element. The BM/C3 element currently exists but will need system improvements to be adjusted accordingly, if the GPALS system is developed and deployed.

Related Environmental Documentation

The EIS will be the umbrella document for the missile defense system acquisition and will serve as the foundation for future system and site-specific environmental documents. A separate and related programmatic EIS is being prepared on TMD because of the distinctive nature of the TMD mission. Other related NEPA documents include the United States Army Kwajalein Atoll (USAKA) Supplemental EIS covering activities associated with experimental and integrated development flight testing in the Republic of the Marshall Islands; site-specific experimental launch activities, such as the EIS on the Strategic Target System (STARS) covering launch activities at the Kauai Test Facility on the Pacific Missile Range Facility, Kauai, Hawaii; and EISs for sites selected for deployment of the NMD segment facilities and assets.

Scoping

This EIS will examine the potential environmental consequences associated with the life-cycle activities for the Proposed Action and alternatives. The document will analyze development,

testing, production, basing and siting, operations and maintenance support, and eventual decommissioning activities. The EIS will focus on broad life-cycle impacts. Follow-on site-specific documents will be written to evaluate possible impacts on areas considered for operations (development, testing, production, and deployment).

A preliminary list of significant topics to be addressed in the PEIS includes, but is not limited to, the following: potential effects of non-ionizing radiation on human and biological populations and on communications elements from testing sensor and communications elements; air quality and ozone depletion effects from rocket exhausts; launch safety and water quality effects resulting from test launches; space debris; impacts on various resource elements and the human environment from generation and use of hazardous materials and disposal of hazardous wastes; and, impacts on strategic mineral resources.

Invitation to Participate

Interested individuals and organizations may participate in the scoping process by providing written statements, recorded statements, or by attending one of the scoping meetings listed below. Statements and public input received as a result of this Notice of Intent and the related scoping process will be used to assist SDIO in identifying the significant issues to be analyzed in depth in this EIS. Individuals or organizations may participate in the scoping process through any or all of the following means:

1. Record requests for additional information by calling the following toll-free number: 1-800-742-2662; for the hearing impaired, the toll-free number is 1-800-223-8488. These lines will be available 24 hours a day through 6 March 1992.

2. Record telephone statements by calling the following toll-free number: 1-800-424-2534.

3. Send written statements or questions to the address below no later than 6 March 1992.

4. Offer verbal statements at scoping meetings at the following times and locations:

Scoping Meetings

Date	Times	Location
Feb. 25, 1992	1-3 p.m., 6:30-8:30 p.m.	Grand Hyatt Hotel 1000 H St. NW. Washington, DC 20001
Feb. 27, 1992	1-3 p.m., 6:30-8:30 p.m.	Los Angeles Hilton 930 Wilshire Blvd. Los Angeles, CA 90017

Written statements and questions about the proposed action and scope of the EIS may be submitted to: Captain Tracy A. Bailey, USAF, P.O. Box 41048, Bethesda, MD 20824.

Written and verbal statements will be considered during the preparation of the EIS. Inputs should be received by 6 March 1992.

Dated: January 29, 1992.

L. M. Bynum,
Alternate OSD Federal Register Liaison Officer, Department of Defense

[FR Doc. 92-2575 Filed 2-3-92; 8:45 a.m.]
BILLING CODE 3810-01-M.

Appendix E

APPENDIX E

DoD ACQUISITION LIFE-CYCLE PROCESS

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DoD ACQUISITION LIFE-CYCLE PROCESS

The process of acquiring a major defense system is governed by a disciplined approach for translating operational needs into stable, cost-effective programs for acquiring quality products. The process consists of discrete logical phases, separated by major decision points called milestones (Figure 2-1). The initiation of acquisition programs requires full examination of alternative ways to satisfy the identified military needs. Once initiated, the program must strike a sensible balance among cost constraints, and schedule and performance objectives. For the purpose of this environmental analysis, each phase in the system acquisition process (DoD, 1991) is described below with a brief discussion of the National Missile Defense (NMD) program activities in that phase.

E.1 CONCEPT EXPLORATION AND DEFINITION

The initial phase in the system acquisition process, concept exploration and definition, involves the study of alternative concepts for satisfying the defined mission. Concept exploration activities can involve some testing but typically focus on "paper studies" to identify the most promising concept(s) and the associated technical risk areas. At the conclusion of the concept exploration and definition phase, a decision must be made to advance the concepts to the next phase in the acquisition process. This decision establishes the formal system acquisition program.

In 1987, the Strategic Defense Initiative program went through a decision to move beyond concept exploration and definition. Environmental Assessments (EAs) were prepared for six system element concepts proposed for transition into the next phase of system development, demonstration and validation (DEM/VAL):

- Battle management/command, control, and communication (BM/C3)
- Exoatmospheric reentry interceptor system
- Ground surveillance and tracking system
- Boost surveillance and tracking system
- Space-based interceptor
- Space surveillance and tracking system

In 1989, an EA was prepared for ground-based radar, completing the set of system element concepts that now form the basis for NMD system alternatives.

E.2 DEMONSTRATION AND VALIDATION

The major objectives of DEM/VAL are to better define the critical design characteristics and expected capabilities of the system concept(s) and to demonstrate that the critical technologies required to make the system work can be incorporated into the system design with confidence. Another objective is to prove that processes critical to implementing the system are understood and attainable. DEM/VAL activities involve greater emphasis on hardware tests which demonstrate the functions of the system elements and their components. Hardware used in DEM/VAL tests is not intended to represent the final system configuration, but must demonstrate the desired design characteristics and capabilities. The final objective of DEM/VAL is to provide the required information to support a decision to enter into the engineering and manufacturing development (EMD) phase of system acquisition with a development baseline for the system containing refined program cost, schedule, and performance objectives.

The interceptor, sensor, and BM/C3 elements which comprise the various NMD system alternatives are currently in the DEM/VAL phase of system acquisition. The results of DEM/VAL testing and research would support the development and definition of EMD alternatives.

E.3 ENGINEERING AND MANUFACTURING DEVELOPMENT

The activities of EMD are the heart of the System Acquisition Alternatives in this programmatic environmental impact statement (PEIS). This phase involves developing the final system design prior to manufacturing. The objectives of EMD are to:

- Translate the most promising system alternative, developed in DEM/VAL, into a stable, producible, and cost-effective system design.
- Validate the manufacturing or production process.
- Demonstrate, through testing, that the system capabilities:
  - Meet contract specification requirements.
  - Satisfy the mission need and meet minimum acceptable operational performance requirements.

Development and Testing (D&T) activities during EMD involve prototype system elements. The use of prototype elements allows verification of the adequacy of manufacturing or production processes, confirms the efficiency of the system design, and provides a realistic basis for production cost

estimates. Tests are conducted to verify that all aspects of the design meet technical and operational requirements.

The complexity and scale of the NMD system would require a progressive approach to engineering D&T. System D&T would begin at the component level and progressively evolve in a building-block approach through subsystem, element, and ultimately system-level integration testing. Integrated system tests would be designed to ensure that the system performs under realistic operational conditions and that there would be personnel capable of operating it. For the NMD program, system-level testing would be built around the BM/C3 element, and concentrate on the functional interactions between system elements. The system test program would assess the ability of the NMD system to collect, store, and move data, including threat data, element status, and command traffic, through the system accurately, effectively, and efficiently in natural and hostile environments in order to accomplish the defense mission.

The NMD test program would be designed to accommodate the needs of the operational test community. There would be an emphasis on using every opportunity during D&T to provide performance data for an early operational assessment, thus reducing the time required for formal operational testing prior to deployment.

E.4 PRODUCTION AND DEPLOYMENT

Once the objectives of EMD have been met, the system acquisition decision maker(s) may decide to proceed with system production and deployment. The objectives of production and deployment are to:

- Establish a stable, efficient production and support base.
- Achieve an operational capability that satisfies the mission needs.
- Conduct follow-on operational and production verification testing to confirm and monitor performance and quality and verify the correction of deficiencies.

For the purpose of analysis in this PEIS, production and deployment activities are discussed separately. Production activities typically carried out at contractor facilities would involve component fabrication and manufacture, component assembly, testing of components and integrated systems, and shipping. Specific manufacturing activities, facilities, and locations would not be determined until the production contractors are selected. Deployment is defined to include basing actions which would be necessary to meet the system operational capability and the system

operations and support activities (formally the final phase of the system acquisition process).

E.5 OPERATIONS AND SUPPORT

Operations and support involve the activities necessary to maintain the system operations required to meet the mission needs. Any system deficiencies identified during this phase may be corrected by system modifications or upgrades.

Operations and support would overlap with deployment since they begin once a system has been fielded. These activities would involve the actions necessary to maintain system operations required to meet the mission need. Any system shortcomings or deficiencies identified during operations and support could be corrected with system modifications or upgrades.

E.6 DECOMMISSIONING

Decommissioning is not a formal phase in the system acquisition process but is a normal conclusion to the system life-cycle. Decommissioning occurs when the system has exceeded its design life and can no longer perform its mission, or when the system is no longer required due to a change in mission need. Decommissioning could involve complete termination of operations and disposal of the system or its replacement with a new, upgraded system.

Appendix E References

DoD, see U.S. Department of Defense.

U.S. Department of Defense, 1991. *Department of Defense Instruction 5000.2* (Defense Acquisition Management Policies and Procedures), Washington, D.C., February 23.

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Appendix F

APPENDIX F

NATIONAL MISSILE DEFENSE

PROGRAM ELEMENT DESCRIPTIONS

APPENDIX F

NATIONAL MISSILE DEFENSE PROGRAM ELEMENT DESCRIPTIONS

Appendix F provides detailed descriptions of each National Missile Defense (NMD) element. The element is defined along with its mission objective and a brief description.

F.1 BATTLE MANAGEMENT/COMMAND, CONTROL AND COMMUNICATIONS ELEMENT

F.1.1 BATTLE MANAGEMENT/COMMAND, CONTROL AND COMMUNICATIONS ELEMENT DEFINITION

The Battle Management/Command, Control and Communications Element (BM/C3) is a ground-based system with space-based elements that enables battle managers to select and engage targets and assess damage (SDIO, 1987). BM/C3 would use computers, satellites, communications, and display systems to monitor the activities and status of the space- and ground-based elements of the NMD system. BM/C3 would be the element used to coordinate a multi-tiered defense against ballistic missile attacks. The system would be designed to operate in a nuclear environment and under direct enemy attack.

F.1.2 MISSION OBJECTIVE

The mission of BM/C3 is to provide the computational power, information display, telecommunications, and decision aids required by NMD system commanders to control and manage their sensors and weapons (SDIO, 1987). BM/C3 system architecture would combine space-based and ground-based equipment linked by a communications network. Surveillance satellites, airborne sensors, and ground radars would locate targets and communicate tracking information to battle managers, which would process the information and communicate target assignments to interceptors.

F.1.3 DESCRIPTION

BM/C3 would be a widely distributed computer network system using advanced processors and data communications links (SDIO, 1987). Computers located at ground-based command centers would be linked by fiber-optic and satellite communications systems. During the boost phase of an attacking missile's trajectory, the BM/C3 would process and distribute sensor data to the command centers, provide rapid and precise characterization of the attack, assign weapons, command sensors to assist in tracking and discrimination and, given proper authority, direct the interception of the attacking missile.

During the midcourse phase, the BM/C3 would distribute sensor data to the command centers, predict hostile intent and probable targets, allocate weapons, control sensor search, use discriminators and multiple sensor data to identify lethal objects, modify strategies as required, and given proper authority, direct the interception of the attacking missile. In the terminal phase, BM/C3 would be the same as during the midcourse phase except that sensor data from ground-based elements would be distributed only to specific battle managers. Decisions and kill assessments would be transmitted to the command centers.

Ground-Entry Points (GEPs) connect the terrestrial communications network and space communications network. GEPs are very similar in both physical and design features to commercial communication satellite dishes used for television and radio signal transmission. To meet survivability and bandwidth requirements, the GEPs will operate at extremely high frequency and will employ the waveforms specified in the BMD Communications Standard. Multiple GEPs would be required.

A GEP will be required at each command center. GEPs provide the primary means for passing operational information to in-flight Ground-Based Interceptors (GBIs) as well as sending and receiving information to and from Space-Based Sensors (SBSs) and Space-Based Interceptors (SBIs).

F.2 GROUND-BASED SENSOR ELEMENTS

This section describes three ground-based sensor (GBS) types which could perform detection, identification, discrimination, and tracking functions. The first two types (GBR) and ground-launched sensors (GLS), would be GBS alternatives within the BMD Program. The third type, upgraded early warning radars (UEWR), is under consideration by the U.S. Air Force. Should the U.S. Air Force pursue this alternative, the BMD system would incorporate this capability.

F.2.1 GROUND-BASED RADAR

F.2.1.1 Element Definition

The GBR would be is an active sensor system which is able to detect and track objects by transmitting electromagnetic radiation (EMR) and detecting reflections off them. GBR would be a phased array radar capable of detecting objects outside the earth's atmosphere, such as intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs). The GBR would provide information on the objects to support interceptor operations, both before interceptor launch and while in flight. The GBR would be capable of detecting objects early enough to support intercepts during the midcourse phase of the flight.

F.2.1.2 Mission Objective

GBR would provide continuous data on missile tracks, and object identification and discrimination during the postboost and midcourse flight phases. GBR would be assigned search zones and could be mechanically trained in any direction. Once an interceptor is committed to an object, GBR would support generation of in-flight target updates (IFTUs) and target object maps (TOMs). IFTUs and TOMs would be provided to the interceptor through the BM/C3. GBR would also collect data to verify the interception of a target.

F.2.1.3 Element Description

Radar detects and tracks objects by transmitting a beam of EMR and detecting reflections of that energy off target objects. The distance and direction of the target can be determined by recording the time delay and direction of the reflected energy. Radar can use a variety of frequencies, but most systems use microwave frequencies between 1 and 40 Gigahertz (GHz; one Gigahertz is an electromagnetic wave frequency of 1 billion waves per second). Frequencies within this range are commonly divided into several bands. The type of system currently being researched would operate in the X-band, between 8 GHz and 12 GHz, or 8,000 and 12,000 Megahertz (MHz); one Megahertz is an electromagnetic wave frequency of 1 million waves per second) (USASSDC, 1993).

The GBR would be a large, complex, high power output, phased array radar system designed in a single-faced, antenna configuration (USASSDC, 1993). The GBR would be designed as a non-mobile system. Radars could be powered by the local electric power grid or by on-site power generators. System components of the GBR would be the antenna/antenna mount, electronics subsystem, displays and controls, cooling system, and electrical power distribution.

The GBR antenna would be placed on the antenna mount, which would be mechanically rotatable in azimuth and elevation (USASSDC, 1993). The GBR would have an effective coverage of 360° horizontally and 90° vertically. The narrow main beam of the GBR could be directed almost instantaneously within the GBR's electronic field of view. Multiple targets could be detected, identified, and tracked by controlling transmission and reception of the microwave signal. The antenna would have a circular aperture of approximately 10 meters (33 feet) in diameter. A planar radome would cover and protect the antenna face from weather.

The GBR electronics subsystem would contain the system data processors, signal processors, high-speed recorders, and the receiver/exciter equipment

(USASSDC, 1993). Software within the subsystem would schedule appropriate beam positions and waveforms, discriminate threatening objects by processing return data, provide data to interceptors, and perform target damage assessment. Transmit/receive arrays consist of components to generate, amplify, and distribute radio frequency energy to the antenna.

The displays and controls would provide the user interface. These GBR operator workstations would provide radar operation control and maintenance status (USASSDC, 1993). A safety system for the GBR would also have appropriate displays and controls for the monitoring of EMR.

Two GBR closed-loop cooling systems would be provided (USASSDC, 1993). Generation and transmission of large amounts of microwave signal energy would create heat in various system components. A demineralized water system would provide cooling for the antenna. Personnel work spaces and additional equipment would be cooled by a typical facility cooling system.

The GBR would require an electrical power distribution system (USASSDC, 1993). It is anticipated that the GBR would use power from the local grid. A multiple-unit 10 to 12 MW diesel-fired power plant with underground fuel storage would be anticipated per GBR site as an emergency backup power source. The GBR would require an extensive power distribution system within the facility and connection to feeder lines from transformers.

F.2.2 GROUND-LAUNCHED SENSOR

F.2.2.1 Element Definition

The GLS would be a fixed, ground-based, rocket-launched, suborbital surveillance system. During an attack, the sensor payload would be boosted into the exoatmosphere on a ballistic trajectory. In the exoatmosphere, the sensor would be uncapped and can perform data collection and reduction.

F.2.2.2 Mission Objective

The GLS would provide a pop-up over-the-horizon sensor capability. The GLS would be boosted into the exoatmosphere. The sensor would then provide surveillance for threat acquisition, discrimination, and tracking through the post-boost, midcourse, and terminal phases of a ballistic missile flight.

F.2.2.3 Element Description

The GLS Air Vehicle (AV) would be based in and launched from a ground-based silo. The GLS would receive its launch authorization from the BMD Operational Commander through the BM/C3 element. The GLS would be

launched only under high-probability threat scenarios. The GLS would not enter orbit and, therefore, would have limited operational life. A recovery system could provide for resealing the sensor payload, deploying a parachute, and activating a signal for recovery.

The AV would consist of a sensor payload on top of a booster. The sensor payload would contain a passive optical sensor; on-board signal and data processors; and guidance, navigation, and control subsystems. The sensor subsystem would consist of a scanning re-imaging telescope, a focal plane assembly, signal processing electronics, and a pointing and stabilization assembly. The combination of ground and on-board signal and data processors would evaluate the sensor detection data and perform threat acquisition, track, discrimination, and interceptor handover. The booster system could be based on the functional equivalent of commercially available vehicles (e.g., Pegasus) or existing government (e.g., Minuteman First and Second stage) boost vehicles which could achieve the required burnout velocities.

F.2.3 UPGRADED EARLY WARNING RADARS

F.2.3.1 Element Definition

The UEWRs would involve upgrading the existing ground-based Tactical Warning and Attack Assessment radars. The EWR system is a network of radars which confirm launches, track, predict launch and impact points, and assess threats of ballistic missiles launched at the continental United States. Specifically, these radars include the Ballistic Missile Early Warning Systems (BMEWS), PAVE phased-array warning system radars, and the COBRA DANE radar. The upgrades would consist primarily of software and software-related hardware changes. Some additional hardware changes in the receiver/exciter could also be necessary.

F.2.3.2 Mission Objective

The UEWR mission would be similar to that of the GBR: to provide improved surveillance data on missile tracks and object identification and discrimination during the post-boost and midcourse flight phases. The BMEWS is a system of ultrahigh frequency (UHF) band radars deployed to provide detection and course track of ballistic missiles aimed at the United States. The PAVE PAWS is a continental United States-based UHF radar system intended to provide warning against ballistic missiles launched from out-of-bastion submarines located offshore.

F.2.3.3 Element Description

Software upgrades would be made to the existing network of radars. No additional facilities would be required. No additional personnel would be

required to operate the radars. Where UEWRs are located in countries other than the United States, agreements with the host nations would be required.

BMEWS radars are located at Clear, Alaska; Thule, Greenland; and Fylindales, England. The radar station in Clear would not be considered for upgrades. PAVE Phased Array Warning System radars are located at Cape Cod Air Force Station, Massachusetts; Beale Air Force Base (AFB), California; Warner-Robins AFB, Georgia; and Eldorado, Texas. The COBRA DANE radar is located at Shemya, Alaska.

F.3 GROUND-BASED INTERCEPTOR ELEMENT

F.3.1 ELEMENT DEFINITION

The GBI would be a fixed-based, battle ready, non-nuclear interceptor missile designed to destroy its target by force of impact. The GBI element would include the interceptor, associated launch equipment and silos, ground support equipment, services, facilities, and personnel.

F.3.2 MISSION OBJECTIVE

The GBI mission would be to intercept and destroy its assigned target by force of impact. The BM/C3 element would integrate sensor data and generate battle management directives to the GBI element. The GBI would execute the interceptor-to-target assignments provided by the BM/C3. The GBI would be employed only in the defense of the United States from a missile attack.

To perform this mission, GBI would be designed to be capable of receiving IFTUs and TOMs from external sensors (i.e., early warning systems, SBSs, GBR) via BM/C3. As a GBI approaches a target, it would select the target as identified in the TOM or uses its on-board sensors to discriminate between the target and other objects. GBI would be capable of controlling its flight path in order to home in on and intercept its target. It would be capable of intercepting and destroying its target outside the earth's atmosphere.

F.3.3 GBI ELEMENT DESCRIPTION

GBI element hardware would consist of AVs (or interceptors), a launch silo, and command and launch equipment.

F.3.3.1 Air Vehicle

The GBI AV would include the boost vehicle (BV) and the kill vehicle (KV) payload. A representative interceptor AV missile would weigh

approximately 4,000 kilograms (8800 pounds), would be approximately 4.5 meters (15 feet) in length, and would be 1 meter (3 feet) in diameter.

Boost Vehicle

The GBI BV would consist of a multistage solid-propellant rocket motor and the payload protective cover shroud. The booster would be designed to provide a standard interface with the KV payload. This would allow future KV upgrades without the need for booster modification. The KV payload would be attached to the top of the BV and be totally enclosed in a shroud.

Two different types of propulsion systems would be used in the GBI element. One would be the launch system to provide axial propulsion (i.e., thrust along the long axis of the interceptor) to push the interceptor through the atmosphere toward the intercept point. A divert propulsion system would provide the KV with flight direction and orientation (BMDO, 1993).

Although several types of solid propellant could be used in the BV, they all would have three basic components: a fuel element (that would provide the energy for propulsion), an oxidizer element (that would chemically react with the fuel to release the fuel's energy), and a binder (that would hold the other two components together in a solid form). Some compounds could serve as both fuel and oxidizer. The binder would also burn and release additional energy (BMDO, 1993).

A number of other additives could be included in the fuel to enhance the speed or evenness of burning. The actual additives used and their proportions would vary considerably. Typical constituents of solid rocket propellants are shown in Table F-1.

Kill Vehicle

The KV payload would include the KV and KV/BV adapter. The KV payload would consist of the seeker/sensor, inertial measurement unit (IMU), avionics, and KV propulsion.

Seeker/Sensor. The seeker would be composed of long-wave infrared and potentially a visible focal plane arrays utilizing common optics technologies. It would be designed to provide long-range acquisition/designation of the threat or targeted object. The field of view would be sized to provide sufficient operational effectiveness in conjunction with the available midcourse external sensors at the time of deployment.

Passive, active, or semiactive seekers/sensors could be used, depending on the characteristics of the target and the background in which the target is acquired (BMDO, 1993). Passive units would detect electromagnetic emissions from the target. They would vary in the wavelengths to which they are sensitive.

Table F-1. Major Constituents of Solid Rocket Propellants

Fuel		
	Powdered aluminum or boron: and/or	10-20% by weight
	Nitrocellulose: and/or	10-60%
	Nitroglycerine: and/or	20-40%
	Cyclotetramethylene tetranitramine	20-30%
Oxidizer		
	Ammonium perchlorate and/or	40-70% by weight
	Ammonium nitrate	70-80%
Binder		
	Butadiene rubber	10-20%

Source: BMDO, 1993

Active seekers/sensors (ladars or radars) would locate targets by emitting EMR and detecting the radiation reflected from the target. Semi-active seekers would be a subset of passive seekers; that is, they would detect EMR from targets that have been illuminated by an external source (e.g., a continuous-wave ladar).

Inertial Measurement Unit. The IMU would be designed to enable the AV to perform autonomous navigation throughout the flight. Star sightings to improve positional and angular accuracies could be performed using the on-board seeker.

The functions of an IMU would be to determine the location of the interceptor, provide reference directions for the seeker/sensor, and separate target motion from interceptor motion (BMDO, 1993). The essence of the IMU unit would be a gyroscopic device with accelerometers.

Avionics. The KV payload would include all avionics, power, and communications necessary to provide vehicle guidance and control processing, perform target designation, and transmit and receive data between all required sources.

The avionics component would translate data from the IMU and/or from the seeker into instructions to the propulsion system (BMDO, 1993). These instructions would steer the missile toward the target and direct the missile to perform attitude adjustments. Avionics would consist of on-board

computers plus their software instructional programs, and the electrical wiring linking these devices to the seeker, guidance, and propulsion systems, as well as to the power source.

While propellant would move the interceptor, the power for the avionics, guidance, and seeker systems would be derived from batteries and distributed to the components through electrical wiring (BMDO, 1993). For GBIs, up to approximately 15 minutes of power are needed for interceptor operation. The main type of batteries to be considered would be reserve lithium thionyl chloride ($Li/SOCl_2$), and reserve lithium/iron disulfide (Li/FeS_2). Another type of battery could be the zinc/silver oxide (Zn/AgO) battery. The shells of these batteries would typically be made of stainless steel or titanium.

KV Propulsion. The KV propulsion would provide reaction and attitude control for the KV payload after booster separation. It would be composed of propellant and pressurant tanks, reaction control system thrusters and attitude control system thrusters. Solid rocket motors would likely be used for the boost propulsion system. However, liquid propellants would often be used in the divert thrusters in the KV to modify and refine the trajectory to guide the interceptor in its terminal flight.

Currently, the most common liquid fuels are hydrazine-based, including monomethyl hydrazine (MMH) and unsymmetrical dimethyl hydrazine (UDMH), which, when mixed with an oxidizer such as nitrogen tetroxide, ignite spontaneously (BMDO, 1993). Nitric acid is also a common propellant constituent, and helium is commonly added as a pressurant. Other liquid propellant constituents that could be utilized include ammonium perchlorate, beryllium hydride, chlorine pentafluoride (ClF_5), deuterium fluoride (DF_2), and chlorine pentafluoride monomethyl hydrazine (ClF_5/MMH).

Several other advanced types of propellants are under development by various aerospace organizations and could find application in interceptor technologies (BMDO, 1993). These include hybrid propellants, consisting of a solid fuel and a liquid oxidizer (similar to those previously discussed) and gelled liquids, which are existing liquid fuels that are mixed with an inert gellant. Propellants that are currently used in a gelled state include MMH and Inhibited Red Fuming Nitric Acid. Gelling of ClF_5 is currently being investigated.

F.3.3.2 Launch Silo

AVs are housed and launched from unmanned fixed launch silos. The silos are underground launch facilities that contain power generation and distribution equipment including generators/batteries; environmental control

mechanisms such as heaters, air conditioners, and sump pumps; and various intrusion detection and prevention equipment. A silo might contain multiple AVs (Barbaro, 1993).

F.3.3.3 Command and Launch Equipment

Command and Launch Equipment would be an assembly of supporting hardware, software, and technical data that would provide for the readiness, launch operations, and supportability of the GBI.

Launch Equipment

Major equipment that would be housed in the silo consists of the launcher and structural electromechanical components; launcher interface equipment, such as processor, storage alignment and external umbilical cord equipment; interactive launch software; and BM/C3 equipment. This would allow for the receipt and transmission of information on system operations from the Regional Operations Center (ROC) and supportability information from the readiness station (RS).

Also included as launch equipment, but not located at the silo, would be the GBI console and associated interfaces at the ROC and RS. The ROC console would serve as a graphic aid and launch operations terminal for the GBI operator supporting the ROC Battle Manager. It would also display current readiness status of GBI major equipment. The RS console would be continuously manned and consist of equipment to monitor the silos. The RS console would provide information on the status of GBI equipment and act as a means to remotely diagnose problems, and effect repairs. The RS would support GBI through central surveillance of all silos for AV readiness, BM/C3 connectivity, and power operations; eliminate the need for permanent launch silo supportability and security manning; and serve as an emergency crew shelter during high states of alert. The RS would not be capable of launching AVs, but could inactivate silos for maintenance and safety.

Ground Support Equipment and Common Facilities

Major ground support equipment critical to maintaining GBI at high mission-capable readiness states would consist of test measurement diagnostic equipment including remote and manually operated hardware, and software; AV handling equipment such as slings, dollies, tie-downs and peculiar transport interface hardware; tools, spares, and repair parts including mission-critical and demand-supported equipment both at onsite and depot operations; and technical data, including drawings, specifications, and other publications. Related equipment and functions not a direct part of GBI, but identified as system-common elements, would include support vehicles; installation services; and maintenance, supply, handling, storage,

and transportation equipment. The process of selecting equipment would give priority to existing commercial and Government equipment that would meet desired system standards in lieu of new research and development efforts.

Facilities common to support ground-based deployment would include mission support, personnel support, infrastructure, off-site, and training facilities. Specific GBI mission support facilities would include missile transfer storage, hazardous fuel storage, and transporter loader facilities.

F.4 SPACE-BASED SENSOR ELEMENTS

F.4.1 ELEMENT DEFINITION

The SBS element would be a distributed space-based surveillance system designed to perform the boost, post-boost, and midcourse tracking mission from booster acquisition (via launch detection system tipoff or priori tasking) through the early terminal phase. Communication between SBS and the other elements would be accomplished by way of the BM/C3 rather than directly with each element. If cued, the SBS could search for a particular target in a specified area.

F.4.2 MISSION OBJECTIVE

The SBS element of the system would be designed to acquire targets, perform tracking and discrimination, provide target data for interceptors, and support target damage assessment through all phases of a ballistic missile flight. The sensor could also provide IFTUs and TOMs to support the intercept mission. SBSs could support both national missile (strategic) defense and theater missile defense mission objectives.

The SBS element would also be capable of monitoring missile flights worldwide during peacetime. The development of an optical sensing database during peacetime would enhance the performance of SBS during wartime. Missile signatures and characteristics could be catalogued, thereby making missiles easier to identify and shortening response time.

F.4.3 ELEMENT DESCRIPTION

The SBS element would consist of a constellation of distributed, lightweight, space-based surveillance satellites which utilize passive sensor technology. The SBS would be placed in orbit using existing space launch vehicles (SLVs) and space launch facilities. Existing SLVs which could be used include the Atlas, Delta, Scout, and Titan expendable launch vehicles, and the Space Transportation System (the Space Shuttle). Existing space launch facilities which could be used include Vandenberg AFB, Kennedy Space Center, and Cape Canaveral Air Force Station. Additionally, the Pegasus air-

launched space booster could be used to flight-test payloads. Surveillance data would be transmitted through the BM/C3 via dedicated GEPs. An element operations center (EOC) would monitor the status of the SBS constellation and maintains the operational readiness of the SBS element.

F.5 SPACE-BASED INTERCEPTOR ELEMENT

F.5.1 ELEMENT DEFINITION

The SBI element would be a distributed space-based system that combines surveillance and intercept functions on a single spacecraft. The SBI would be able to detect and track ballistic missiles in their boost, post-boost, and midcourse phases of flight. Upon receipt of the appropriate signal from the system operator, one or more SBI spacecraft could release interceptors toward a target. The SBI would be able to perform the necessary computations and communicate with other SBI spacecraft to assign the appropriate interceptor to a selected target. The interceptor would destroy the target by direct impact or collision at very high speed. The SBIs could also provide protection of the SBSs against anti-satellite attacks.

F.5.2 MISSION OBJECTIVE

The purpose of the SBI element would be to intercept and destroy ballistic missiles or their deployed reentry vehicles in the boost, post-boost, or midcourse phase of flight.

F.5.3 ELEMENT DESCRIPTION

The SBI element would include an EOC, with dedicated GEP and logistics and support. The EOC would be the primary interface between the SBI element and the rest of the system, and would be responsible for overall space segment control and support.

SBI would be placed in orbit with an existing booster system such as Atlas IV or Delta II from existing launch facilities. Depending on the booster used, as many as 80 SBIs could be launched at one time. As many as 1,000 SBIs could be deployed to provide defense against a limited or accidental ballistic missile attack anywhere in the world.

Each SBI satellite contains the interceptor which would remain dormant until activated through BM/C3 commands. The SBI satellite would provide "life-support" to the interceptor by physically protecting the interceptor and by maintaining communications with the EOC as well as surveillance of possible threat objects. Power to run on-board electronics and software would be provided by photovoltaic cells (which convert sunlight into electric power) and batteries.

The SBI would be similar to the GBI. The SBI would rely on impact with the target to destroy it. The systems that would be used in the SBI are similar to those in the GBI. One difference would be that less axial propulsion is required for SBI. Since the SBI would already be outside the earth's atmosphere, less propellant would be needed to provide axial propulsion. Axial propulsion for SBI could be either solid or liquid, similar to those being considered for GBI. Subsystems which provide satellite steering or maneuvering capability would most likely use liquid propellants.

Appendix F References

BMDO, see Ballistic Missile Defense Organization.

Ballistic Missile Defense Organization, 1993. *Final Theater Missile Defense Programmatic Life-Cycle Environmental Impact Statement*, Washington, D.C., September.

Barbaro, A., 1993. Personal Communication with K. Donnelly, Halliburton NUS Corporation, 6 January.

SDIO, see Strategic Defense Initiative Organization.

Strategic Defense Initiative Organization, 1987. *Battle Management/Command and Control, and Communications (BM/C3) Environmental Assessment*, Washington, D.C., August.

USASSDC, see U.S. Army Space and Strategic Defense Command.

U.S. Army Space and Strategic Defense Command, 1993. *Ground Based Radar (GBR) Family of Strategic and Theater Radars Environmental Assessment*, Huntsville, Alabama, June.

Appendix G

APPENDIX G

REGULATORY INFORMATION

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REGULATORY INFORMATION

This appendix provides information on applicable regulations used in the assessment of environmental impacts in this Programmatic Environmental Impact Statement (PEIS). Section G.1 includes a description of each applicable federal statute, executive order, U.S. Department of Defense (DoD) Directive, and Military Standard. Table G-1, at the end of this chapter, lists the principal regulatory statutes which will be applied as a result of the proposed action. Section G.2 discusses the applicability of environmental regulations to the issues and concerns identified in Chapter 3 and identifies whether the issues and concerns would be regulated principally under federal regulations, state or local regulations, or be unregulated. Section G.2 is also a synopsis of the principal environmental statutes governing impacts to each of the 14 environmental topics considered in this PEIS.

G.1 FEDERAL STATUTES, EXECUTIVE ORDERS, DoD DIRECTIVES, AND MILITARY STANDARDS

This section lists federal statutes, Executive Orders, DoD Directives, and Military Standards which may be relevant to the impacts of Alternatives considered in this PEIS. Each item is listed and briefly described.

G.1.1 FEDERAL STATUTES AND EXECUTIVE ORDERS

The following federal statutes and executive orders were considered in the preparation of this PEIS.

G.1.1.1 American Indian Religious Freedom Act (42 USC 1996 et seq.)

The American Indian Religious Freedom Act (AIRFA) is intended to preserve Native Americans' right to believe, express, and protect their traditional religions. The Act gives Native Americans the right of access to traditional religious sites, the use and possession of sacred objects, and the freedom to worship through traditional rites and ceremonies.

G.1.1.2 Anadromous Fish Conservation Act (16 USC 757a et seq.)

The Anadromous Fish Conservation Act is intended to conserve, develop, and enhance anadromous fish, which spawn in fresh water or estuaries and migrate to ocean waters, and anadromous fishery resources of the United States that are subject to depletion from water resource developments.

Table G-1. Principal Regulatory Statutes Governing Impacts to Resource Areas Addressed in this PEIS (Sheet 1 of 4)

Resource Area	Principal Federal Regulatory Statutes[1]	State and Local Statutes and Ordinances
Air Quality	Clean Air Act	States enforce the Clean Air Act (state implementation plans) and regulate air emissions to a greater degree than does the federal Government.
Upper Atmosphere and Space	Clean Air Act	Many state air quality statutes regulate air emissions to a greater degree than does the Clean Air Act. Otherwise, the upper atmosphere and space are not specifically addressed by state or local regulations.
Electromagnetic Radiation	Human Health: Occupational Safety and Health Act	Some states regulate electromagnetic radiation.
	Wildlife: See Biological Resources	
Hazardous Materials and Waste	Resource Conservation and Recovery Act	Most states regulate the handling and disposal of hazardous materials and waste.
	Federal Facilities Compliance Act	
	Pollution Prevention Act	
	Comprehensive Environmental Response, Compensation, and Liability Act	
	Hazardous Materials Transportation Act	
Noise	Noise Control Act	Noise generation is regulated under many local ordinances.
	Occupational Safety and Health Act	

Table G-1. Principal Regulatory Statutes Governing Impacts to Resource Areas Addressed in this PEIS (Sheet 2 of 4)

Resource Area	Principal Federal Regulatory Statutes[1]	State and Local Statutes and Ordinances
Safety	Occupational Safety and Health Act	Some states regulate safety issues.
	Hazardous Materials Transportation Act	
	Radiation Control for Health and Safety Act	
Surface Water	Quality: Clean Water Act Marine Protection, Research, and Sanctuaries Act	Quality: Some states have assumed responsibility for enforcing the Clean Water Act and regulate surface water discharges to a greater degree than does the federal Government.
	Quantity: None Floodplains: Executive Order 11988, Protection of Floodplains	Quantity: Many states regulate the withdrawal and appropriation of surface water.
Groundwater	Quality: Safe Drinking Water Act	Quality: Some states have assumed responsibility for enforcing the Safe Drinking Water Act and enforce it more strictly than does the federal Government.
	Resource Conservation and Recovery Act	
	Quantity: None	Quantity: Many states regulate the withdrawal and appropriation of groundwater.
Visual Resources	Clean Air Act	Impacts to visual quality are usually regulated under local ordinances.

Table G-1. Principal Regulatory Statutes Governing Impacts to Resource Areas Addressed in this PEIS (Sheet 3 of 4)

Resource Area	Principal Federal Regulatory Statutes[1]	State and Local Statutes and Ordinances
Cultural Resources and Native Populations	Cultural Resources: National Historic Preservation Act	Some state statutes and local ordinances regulate cultural resources not under federal regulation.
	Native American Rights: American Indian Religious Freedom Act	
	Native American Graves Protection and Repatriation Act	
Biological Resources and Wetlands	Threatened/Endangered Species: Endangered Species Act	Many state statutes protect state-listed threatened and endangered species not protected under the Endangered Species Act.
	Wetlands: Clean Water Act (Section 404)	Many states protect wetlands to a greater degree than they are protected under Section 404 of the Clean Water Act.
	Executive Order 11990, Protection of Wetlands	
	Migratory Birds: Migratory Bird Treaty Act	Some state statutes regulate the taking of migratory birds.
	Bald and Golden Eagle Protection Act	Some states have special protection measures for raptors.

Table G-1. Principal Regulatory Statutes Governing Impacts to Resource Areas Addressed in this PEIS (Sheet 4 of 4)

Resource Area	Principal Federal Regulatory Statutes[1]	State and Local Statutes and Ordinances
Land Use	Wild and Scenic Rivers Act	Land use impacts are usually regulated under local ordinances.
	Executive Order 12372	
	Intergovernmental Review of Federal Programs	
	Federal Land Policy and Management Act	
	Coastal Zone Management Act	
Socioeconomics	None	Generally unregulated.
Geology and Soils	Farmland Policy Protection Act Soil Conservation and	Many states have soil conservation statutes and require the approval of soil erosion and sediment control plans for areas of disturbed soils.
	Domestic Allotment Act	

(1) The Federal regulatory statutes are implemented, and the authorization for carrying out the regulations are found in the Code of Federal Regulations (CFR). The CFR in turn requires the states to establish or adopt related regulations.

G.1.1.3 Antiquities Act (16 USC 431 et seq.)

The Antiquities Act authorizes the President to designate as national monuments any historic landmarks and historic and prehistoric sites, structures, and objects situated on federal land. The Act establishes the requirement of a permit for the examination or excavation of such nationally important sites and establishes penalties for their destruction.

G.1.1.4 Archaeological and Historic Preservation Act (16 USC 469a et seq.)

The Archaeological and Historic Preservation Act is intended to preserve the historic and archaeological data that would be lost due to federal construction. If a federal agency determines that the Proposed Action may cause irreversible damage to archaeological resources, it must notify the U.S. Department of the Interior (U.S. DOI), which would authorize the agency to excavate and would protect the archaeological resources and data.

G.1.1.5 Archaeological Resources Protection Act (16 USC 470a et seq.)

The Archaeological Resources Protection Act increases protection of the archaeological resources and sites on public or Native American land. It is also intended to increase cooperation and the exchange of information between Government authorities, professional archaeological communities, and custodians of private collections which were obtained before its promulgation. The Act authorizes the major federal land-managing agencies to establish permit systems for the excavation or removal of archaeological resources located on public or Native American land.

G.1.1.6 Atomic Energy Act (42 USC 2011 et seq.)

The Atomic Energy Act is intended to promote the general welfare of the U.S., increase the standard of living, and strengthen free competition in private enterprise through peaceful applications of atomic energy. The Atomic Energy Act designated the Atomic Energy Commission and its successor agencies responsible for public health and safety with regard to the construction and operation of nuclear facilities and the use of source, by-product, and special nuclear materials.

G.1.1.7 Bald and Golden Eagle Protection Act (16 USC 668 et seq.)

The Bald and Golden Eagle Protection Act makes it illegal to take, pursue, molest, or disturb American bald and golden eagles, their nests, or their eggs anywhere in the U.S. A permit from the U.S. DOI is required to relocate a nest if it is necessary for resource development. If a nest is found in the vicinity of the site of a Proposed Action, the federal agency

initiating the proposed action needs to consult with the U.S. DOI regarding proper procedures under this Act. American bald eagles also are protected under the Endangered Species Act (ESA).

G.1.1.8 Clean Air Act (42 USC 7401 et seq.)

The Clean Air Act (CAA) is intended to protect and enhance the nation's air resources so as to promote public health and welfare and the productive capabilities of its population. The CAA of 1970 established National Ambient Air Quality Standards (NAAQS) for carbon monoxide, total suspended particulates, sulfur dioxide, hydrocarbons, nitrogen dioxide, and photochemical oxidants. The National Ambient Air Quality Standards are intended to give the public an adequate margin of safety for protection from adverse health and welfare effects due to exposure to various pollutants. In 1976, a NAAQS for lead was established. In 1979, the photochemical oxidants standard was revised and restated as an ozone standard. The hydrocarbon standard was withdrawn in 1983. In 1987, the total suspended particulates standard was reviewed and revised to include only particles with an aerodynamic particulate diameter of less than or equal to 10 microns, referred to as PM_{10}.

The Clean Air Act Amendments of 1990 (CAAA) strengthened the CAA. The Amendments gave the U.S. Environmental Protection Agency (U.S. EPA) the authority to designate counties and Metropolitan Statistical Areas that do not meet the NAAQS as nonattainment areas. If an area is designated as a nonattainment area, it must achieve the NAAQS by a specified date based on the concentration of the pollutant in the air. Also, the construction of any new major source of a pollutant in a nonattainment area for that pollutant requires a permit, and the new source must be equipped with pollution controls to ensure the lowest achievable emissions. In addition, if the new source is located near a Class I area (national parks and wilderness areas), the impact on visibility must be assessed.

The CAAA have established phaseouts for the production of compounds which reduce ozone levels in the uppermost layer of the atmosphere, the stratosphere. Class I ozone depleting compounds, including chlorofluorocarbons (CFCs), carbon tetrachloride, methylbromide, and methyl chloroform are scheduled for phaseout in 1996. Class II ozone depleting compounds, hydrochlorofluorocarbons (HCFCs), have a gradual phaseout which begins in 2000.

G.1.1.9 Clean Water Act (33 USC 1251 et seq.)

Under the Clean Water Act (CWA) it is illegal to discharge pollutants from a point source into the navigable waters of the United States including interstate and intrastate lakes, rivers, streams, wetlands, playa lakes, prairie potholes, mudflats, seasonal streams, and wet meadows), except in

compliance with a National Pollutant Discharge Elimination System (NPDES) permit.

Section 404 of the CWA makes it illegal to discharge dredged or fill material into the waters of the U.S. unless authorized by the U.S. Army Corps of Engineers (U.S. COE), or with a permit issued by the U.S. COE.

G.1.1.10 Coastal Zone Management Act (16 USC 1451 et seq.)

The Coastal Zone Management Act is intended to preserve, protect, develop, and, where possible, restore or enhance the resources of the nation's coastal zone, which include coastal waters and the adjacent shorelines, islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. The Coastal Zone Management Act gives grants to coastal states that develop management programs to minimize damage caused by improper development in flood-prone, storm-surge, geological-hazard, and erosion-prone areas, and the destruction to beaches, dunes, wetlands, and barrier islands.

G.1.1.11 Comprehensive Environmental Response, Compensation, and Liability Act (42 USC 9601 et seq.)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and its amendments, the Superfund Amendments and Reauthorization Act (SARA), the Emergency Planning and Community Right-to-Know Act (EPCRA), and the Omnibus Budget Reconciliation Act of 1990, provide liability and compensation cleanup, and emergency response by the federal government for hazardous waste released into the environment and for the cleanup of inactive hazardous waste disposal sites.

G.1.1.12 Earthquake Hazards Reduction Act (42 USC 7701 et seq.)

The purpose of this act is to reduce the risk to life and property from future earthquakes through the establishment and maintenance of an effective earthquake hazards reduction program. The objectives of the program include: 1) earthquake-resistant construction; 2) earthquake prediction; 3) development of model building codes; 4) understanding of earthquake-related issues; 5) public education; 6) research into earthquake mitigation, consequences of earthquake prediction, and earthquake insurance; and 7) research into control or alteration of seismic phenomena. The DoD is one of the many federal Government agencies participating in this program.

G.1.1.13 Endangered Species Act (16 USC 1531 et seq.)

The Endangered Species Act, through Section 7, requires that Federal agencies ensure that any actions "authorized, funded, or carried out" will not jeopardize the continued existence of a species listed as endangered or

threatened or result in adverse modification of designated critical habitat. The Endangered Species Act also requires that Federal agencies consult with the U.S. Fish and Wildlife Service (U.S. FWS) regarding any project that may affect a listed species, or confer with the U.S. FWS regarding any action that may jeopardize a species proposed for listing or result in the destruction or adverse modification of proposed critical habitat.

G.1.1.14 Energy Reorganization Act (42 USC 5801 et seq.)

The Energy Reorganization Act is intended to make the nation more self-sufficient in energy usage so as to restore, protect, and enhance environmental quality and to ensure public health and safety. Under Section 5846 all licensed facilities must comply with the regulations as set forth by the Atomic Energy Act of 1954.

G.1.1.15 Executive Order 11593, Protection and Enhancement of the Cultural Environment

Executive Order 11593 requires federal agencies to locate, inventory, and nominate qualifying properties under their jurisdiction or control to the *National Register of Historic Places*. This process requires Federal agencies to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of a proposed activity on any potentially eligible or listed historic resource.

G.1.1.16 Executive Order 11988, Floodplain Management Executive Order 11990, Protection of Wetlands

Executive Order 11988 requires federal agencies to develop procedures that consider potential flood hazards and floodplain management criteria when undertaking a project in a floodplain area, and avoid floodplain impacts to the fullest extent possible. Executive Order 11990 requires all federal agencies to consider protection of wetlands in the choice of a site for a Proposed Action.

G.1.1.17 Executive Order 12088, Federal Compliance With Pollution Control Standards

Federal agencies are responsible for prevention, control, and abatement of environmental pollution from facilities and activities under their control and for compliance with applicable pollution control standards, including those established pursuant to the Noise Control Act.

G.1.1.18 Executive Order 12114, Environmental Effects Abroad of Major Federal Actions

Executive Order 12114 requires that the officials of federal agencies having the responsibility for authorizing and approving major federal action abroad are informed of pertinent environmental considerations, and take those considerations into account with other pertinent national policy considerations, when making decisions regarding major actions abroad.

G.1.1.19 Executive Order 12372, Intergovernmental Review of Federal Programs

Executive Order 12372 directs federal agencies to consult with and solicit comments from state and local government officials whose jurisdictions would be affected by federal actions.

G.1.1.20 Executive Order 12843, Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances

Executive Order 12843 requires that federal agencies, to the extent possible, conform their procurement regulation and practices to the policies and requirements of Title VI of the CAAA. Federal agencies must also maximize their use of safe alternatives to ozone-depleting substances, evaluate present and future use of ozone-depleting substances, and evaluate the potential for recycling programs.

G.1.1.21 Executive Order 12856, Federal Compliance With Right-to-Know Laws and Pollution Prevention Requirements

Executive Order 12856 requires that the head of each federal agency be responsible for ensuring that all necessary actions are taken for the prevention of pollution with respect to the agency's activities and facilities. The head of each federal agency also is responsible for ensuring that the agency complies with pollution prevention, emergency planning, and community right-to-know provisions established pursuant to 42 USC 13101 et seq., "Pollution Prevention Act," and 42 USC 11001 et seq., "EPCRA" (amendments to CERCLA).

G.1.1.22 Farmland Protection Policy Act (7 USC 4201 et seq.)

The Farmland Protection Policy Act (FPPA) is intended to reduce the conversion of farmland to nonagriculture uses by federal projects and programs. It requires that federal projects and programs comply to the fullest extent possible with state and local government policies to preserve farmland.

G.1.1.23 Federal Caves Resources Protection Act (16 USC 4301 et seq.)

The Federal Caves Resources Protection Act is intended to secure, protect, and preserve significant caves on federal lands for the perpetual use, enjoyment, and benefit of all people. The Act requires that federal lands be managed in a manner which protects and maintains, to the greatest extent possible, all significant caves. It also requires a permit for the collection and removal of cave resources from caves on federal lands.

G.1.1.24 Federal Facility Compliance Act of 1992 (42 USC 6901 et seq.)

The Federal Facility Compliance Act gives any state that has an authorized hazardous waste program the authority to conduct an inspection of any facility which manages hazardous waste, including federal facilities, for the purpose of enforcing the facilities' compliance with the state's program. Any funds received by the state from federal facilities must be used to improve hazardous waste facilities, protect the environment, or defray the costs of enforcement if these funds have not already been allocated a use by the state's Constitution.

G.1.1.25 Federal Insecticide, Fungicide, and Rodenticide Act (7 USC 136 et seq.)

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the use of pesticides. Before a pesticide can be sold in the United States, the U.S. EPA must determine that there are no unreasonable effects on humans and the environment with its approved use. If it is found to pose an unreasonable risk to the environment, U.S. EPA is authorized to suspend or restrict its use. All pesticides that have been approved by the U.S. EPA must be labeled showing the approved uses and restrictions. It is a violation of law to use a pesticide in a manner inconsistent with its label.

G.1.1.26 Federal Land Policy and Management Act (43 USC et seq.)

The Federal Land Policy and Management Act declares that all public lands will be retained in federal ownership unless it is determined that a use other than public will better serve the interests of the nation. The Federal Land Policy and Management Act also requires that all public land be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, and environmental aspects of the land, and it requires that all public lands and their resources be inventoried periodically and systematically.

G.1.1.27 Fish and Wildlife Coordination Act (16 USC 661 et seq.)

The Fish and Wildlife Coordination Act is intended to ensure that fish and wildlife conservation receives consideration and is coordinated with water resource development programs through planning, development, maintenance, and coordination of wildlife conservation and rehabilitation. The Act applies whenever the waters of any stream or other body of water greater than or equal to 4 hectares (10 acres) in surface area is proposed or authorized to be controlled or modified for any purpose by any department or agency of the U.S., or any public or private agency under federal permit or license.

G.1.1.28 Fishery Conservation and Management Act (16 USC 1801 et seq.)

The purpose of the Fishery and Conservation Management Act is to conserve and manage the fishery resources found off the coast of the U.S., the anadromous species, and the Continental Shelf fishery resources. The Act establishes conservation zones within which the U.S. has exclusive authority over fishery resources, and beyond which the U.S. has authority over anadromous and Continental Shelf fishery resources. The Act also establishes Regional Fishery Management Councils which are responsible for preparing, monitoring, and revising plans that promote sound domestic commercial and recreational fishing under conservation and management principles of the Act.

G.1.1.29 Geothermal Steam Act (30 USC 1002 et seq.)

The Geothermal Steam Act states that the Secretary of the Interior may issue leases for the development of geothermal resources in lands administered by him, including public, withdrawn, and acquired lands.

G.1.1.30 Hazardous Materials Transportation Act (49 USC 1801 et seq.)

The Hazardous Materials Transportation Act (HMTA) is intended to protect the nation from risks to life and property associated with the transportation of hazardous materials in commerce. Under the Act, if the transportation of a particular quantity and form of material poses unreasonable risks to the health and safety of property, it may be classified as a hazardous material. Hazardous material is subject to transportation regulations, which include packing, labeling, and routing requirements, and handling regulations, which include number of personnel, level of training, and type and frequency of training.

G.1.1.31 Historic Sites Act (16 USC 461 et seq.)

The Historic Sites Act establishes a national policy to preserve historic sites, buildings, and objects of national importance. The Act gives the Secretary of the Interior the authority to designate sites of national significance and acquire privately owned historic properties.

G.1.1.32 Marine Mammal Protection Act (16 USC 1361 et seq.)

The Marine Mammal Protection Act is intended to protect certain species and population stocks of marine mammals that are or may be in danger of extinction or depletion. The Marine Mammal Protection Act differs from the ESA in that it allows the states to determine when a species is below its optimum sustainable population and should be protected. Under Section 1374, permits for the taking of marine mammals may be issued by the Secretary of the Interior.

G.1.1.33 Marine Protection, Research, and Sanctuaries Act (33 USC 1401 et seq.)

The Marine Protection, Research, and Sanctuaries Act regulates the dumping of all materials into ocean waters and is intended to prevent or limit the dumping of materials that could adversely affect human health and welfare, the marine environment, ecological systems, or economic potentialities.

G.1.1.34 Migratory Bird Treaty Act (16 USC 703 et seq.)

The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns among the U.S., Canada, Mexico, Japan, and the former Soviet Union. The Act makes it illegal to "kill ... any migratory bird," or disturb nests or eggs, except as permitted by the Act. The Act also controls the harvest of such birds by establishing hunting seasons, bag limits, and methods of harvest.

G.1.1.35 National Environmental Policy Act (42 USC 4321 et seq.)

The National Environmental Policy Act (NEPA) is the driving force behind the environmental impact statement (EIS). The Act was established to promote an awareness of the environment, to provide a method for assessing the environmental consequences of proposed federal projects and activities, and to establish the Council on Environmental Quality (CEQ). Under NEPA, several levels of investigation and documentation may be initiated, depending on the project type and the projected environmental impacts. The Act requires that all agencies of the federal Government prepare a detailed EIS on any proposed federal action that might have a significant effect on the quality of the human environment. The CEQ has developed

"Regulations on Implementing the National Environmental Policy Act" (40 CFR 1500-1508) to clarify and implement the EIS process.

G.1.1.36 National Historic Preservation Act (16 USC 470 et seq.)

The National Historic Preservation Act (NHPA) requires that places of national historic importance be placed on the National Register of Historic Places (NRHP). Under NHPA, the officials of federal agencies must assume responsibility for the preservation of historic properties owned or controlled by their agencies. Each agency must undertake the preservation of such properties and initiate measures to ensure that when a historic property is altered substantially or demolished, steps are taken to have appropriate records made. Under Section 106 of the NHPA, federal agencies must consult with State Historic Preservation Officer (SHPO) to consider the impacts of the actions they sponsor, fund, or authorize on historic properties.

G.1.1.37 Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)

The Native American Graves Protection and Repatriation Act (NAGPRA) requires that if human remains or cultural items are discovered during an excavation on federal land, the culturally affiliated tribe(s) or organization(s) must be consulted to ensure their appropriate disposition and control. Consultations would result in delays in project construction and could result in engineering changes.

G.1.1.38 Noise Control Act (42 USC 4901 et seq.)

The Noise Control Act (NCA) and its amendments (Quiet Communities Act) are intended to promote an environment for all Americans that is free from noise that may jeopardize their welfare by establishing noise standards for certain sources, developing noise criteria, and encouraging development of local noise control programs. The Act requires that federal agencies minimize the noise impacts of their projects on the surrounding communities.

G.1.1.39 Occupational Safety and Health Act (29 USC 651 et seq.)

The Occupational Safety and Health Act is intended to provide a safe and healthful working environment for every working person as far as possible in order to preserve our human resources. Under the Act every employer must provide a workplace that is free from known hazards that might cause either death or serious physical harm to its employees, and all employees must comply with the safety and health requirements. The Secretary of Labor is also required to set mandatory occupational health and safety standards for all businesses involved in interstate commerce.

G.1.1.40 Pollution Prevention Act (42 USC 13101 et seq.)

The Pollution Prevention Act establishes a national policy of pollution prevention through source reduction of hazardous materials or through recycling, treatment, and disposal of hazardous waste, in that priority. The Act stipulates the establishment of a nationwide source-reduction program and a strategy for quantifying source-reduction efforts.

G.1.1.41 Public Buildings, Property, and Works Act ("Engle Act") (43 USC 158 et seq.)

The Engle Act states that all minerals, including oil and gas, in DoD lands are under the jurisdiction of the Secretary of the Interior and applicable public land mining and mineral leasing laws. Mineral resources on DoD lands can be developed, but only if the Secretary of Defense determines that the development is consistent with the military uses of the land. The Mineral Leasing Act for Acquired Lands (30 USC 352) describes restrictions similar to those in the Engle Act.

G.1.1.42 Radiation Control for Health and Safety Act (42 USC 263b et seq.)

The Radiation Control for Health and Safety Act is intended to protect the public health from unnecessary radiation emissions of electronic products, including televisions, microwaves, X-rays, accelerators, laser products, and other products generating intense magnetic fields.

G.1.1.43 Resource Conservation and Recovery Act (42 USC 6901 et seq.)

The Resource Conservation and Recovery Act (RCRA) is intended to promote the protection of both health and the environment and to conserve valuable materials and energy resources. The Act regulates the treatment, storage, transportation, and disposal of hazardous waste and nonhazardous solid waste. The Act also regulates the operation of underground tanks used to store petroleum products and hazardous materials.

G.1.1.44 Rivers and Harbors Appropriation Act (33 USC 401 et seq.)

The Rivers and Harbors Appropriation Act prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. The Act also prohibits construction in or over a navigable water, excavation of or dumping of materials into a navigable water, or conducting any project that would alter the course or capacity of navigable water unless it has been recommended by the U.S. COE and authorized by the Secretary of the Army.

G.1.1.45 Safe Drinking Water Act (42 USC 300 et seq.)

The Safe Drinking Water Act (SDWA) is intended to protect the water supply and distribution systems of the public water systems and protect the sources of drinking water.

G.1.1.46 Soil Conservation and Domestic Allotment Act (16 USC 590a et seq.)

The Soil Conservation and Domestic Allotment Act is intended to preserve natural resources, control floods, prevent impairment of reservoirs, maintain navigability of rivers and harbors of the U.S., and protect public health and land by controlling and preventing soil erosion on public lands.

G.1.1.47 Toxic Substances Control Act (15 USC 2601 et seq.)

The Toxic Substances Control Act (TSCA) requires the U.S. EPA to test chemical substances and mixtures to determine if they constitute an unreasonable risk to health or the environment. If the U.S. EPA has determined that chemical substances or mixtures constitute a risk, it has the ability to regulate their manufacture, use, labeling, and disposal. If the U.S. EPA has determined that a chemical substance or mixture is extremely hazardous, posing an unreasonable risk of serious or widespread injury, it has the authority to seize the substance or notify the purchaser and/or the public of the risks associated with its use.

G.1.1.48 Watershed Protection and Flood Prevention Act (16 USC 1001 et seq.)

The Watershed Protection and Flood Prevention Act is intended to prevent the loss of life and the damage of property caused by erosion, floodwater, and sediment damage within the watersheds of the rivers and streams of the U.S. The Act provides for the conservation, development, utilization, and disposal of water, and the conservation and utilization of land to preserve, protect, and improve the nation's land and water resources as well as the quality of the environment.

G.1.1.49 Wild and Scenic Rivers Act (16 USC 1274 et seq.)

The Wild and Scenic Rivers Act provides for protection of the free-flowing, scenic, and natural values of rivers designated as components or potential components of the National Wild and Scenic Rivers System. No license, permit, or other authorization can be issued for a federally assisted water resources project that could have an adverse impact on the values for which a river was designated as a wild and scenic river. For portions of rivers under study for addition to the National Wild and Scenic River System, existing projects may be operated in accordance with existing licenses,

permits, and agreements. New projects are allowed, but they must be planned, designed, located, and constructed to minimize adverse effects on the values for which the river is under study, and they must use existing structures and facilities to the extent practicable.

G.1.1.50 Wild Free-Roaming Horses and Burros Act (16 USC 1331 et seq.)

The Wild Free-Roaming Horses and Burros Act protects wild free-roaming horses and burros from capture, branding, harassment, or death; therefore, the horses and burros are considered, in the areas where found, to be an integral part of the natural system of the public lands.

G.1.2 DoD DIRECTIVES

The following DoD Directives were considered in the preparation of this PEIS.

G.1.2.1 DoD Directive 1000.3, Safety and Occupational Health Policy for the Department of Defense

DoD Directive 1000.3 requires that comprehensive safety programs be implemented in an attempt to protect DoD personnel and the public from accidental death, injury, or occupational illness, and to protect DoD weapon systems from accidental destruction or damage. The safety program must comply with applicable federal and state safety, occupational, and environmental health regulations.

G.1.2.2 DoD Directive 3222.3, Department of Defense Electromagnetic Compatibility Program

DoD Directive 3222.3 requires that the Electromagnetic Compatibility Program apply to conception, design, and operational phases for all military electronic and telecommunications equipment, subsystems, and systems. The Directive also requires that standards and specifications for design, development, production, testing, and measurements related to electromagnetic compatibility be developed.

G.1.2.3 DoD Directive 4210.15, Hazardous Material Pollution Prevention

DoD Directive 4210.5 requires that DoD select, use, and manage hazardous material over its life cycle so as to incur the lowest possible cost required to protect human health and the environment. The Directive also requires that DoD avoid or reduce where possible the use of hazardous materials, follow the appropriate regulations governing the use and management of hazardous materials, and apply management practices that avoid harm to human health or the environment.

G.1.2.4 DoD Directive 4165.57, Air Installations Compatible Use Zone

DoD Directive 4165.57 requires that all reasonable efforts be taken to reduce or control the generation of noise from flying and flying-related activities. It also requires that DoD try to achieve compatibility between air installations and nearby neighborhood communities through compatible land use planning.

G.1.2.5 DoD Directive 4700.4, Natural Resource Management Program

DoD Directive 4700.4 requires DoD to manage and conserve all natural resources, including watersheds, natural landscapes, forests, fish and wildlife, and protected species, under its control. There will also be conscious concern for the inherent value of these natural resources in all DoD plans, activities, and programs.

G.1.2.6 DoD Directive 4710.1, Archeological and Historic Resources Management

DoD Directive 4710.1 requires that DoD policy integrate the archeological and historic preservation requirements of applicable federal laws with the planning and management of activities under their control.

G.1.2.7 DoD Directive 5000.1, Part 6, Section 1, Systems Safety, Health Hazards, and Environmental Impact

DoD Directive 5000. 1, Part 6, Section 1 establishes the basis for integrating system safety, health hazards, and environmental considerations into the systems engineering process. Through this process, safety and health objectives will be established as soon as possible and will be used to guide the appropriate activities. The process not only requires the management of hazardous materials waste products, but also the reduction of hazardous materials usage. Part 6, Section 1 also requires that the proposed project be analyzed in accordance with NEPA and with Executive Order 12114, Environmental Effects Abroad of Major Federal Actions.

G.1.2.8 DoD Directive 5030.41, Oil and Hazardous Substance Pollution Prevention and Contingency Program

DoD Directive 5030.41 prohibits all DoD facilities from intentionally discharging oil or hazardous substances into or upon the waters of the U.S., adjoining shorelines, or waters of the contiguous zone. Directive 5030.41 requires that spill prevention and countermeasure plans be developed for each installation or activity. The Directive also prohibits the use of dispersant except when necessary to reduce fire or safety hazards.

G.1.2.9 DoD Directive 6050.1, Environmental Effects in the U.S. of Department of Defense Actions

DoD Directive 6050.1 requires that DoD act in a manner that is consistent with national environmental policies and use the means and measures needed to protect, restore, and enhance the quality of the environment, to avoid or minimize adverse environmental consequences, and to preserve historic, cultural, and natural aspects of our national heritage.

G.1.2.10 DoD Directive 6050.5, DoD Hazard Communication Program

DoD Directive 6050.5 requires that all DoD facilities comply with the Occupational Safety and Health Administration. The Directive requires that DoD protect its personnel from adverse effects of hazardous materials and wastes in order to reduce chemical-related injuries and illnesses in the workplace. The Directive also requires that all personnel who work with hazardous materials or wastes be aware of the hazards that they could be exposed to, of exposure symptoms and first aid treatment, of precautionary measures, of protective equipment and control devices, and of proper waste disposal instructions.

G.1.2.11 DoD Directive 6050.7, Environmental Effects Abroad of Major Department of Defense Actions

DoD Directive 6050.7 requires that DoD take into account environmental considerations when it acts abroad, and that it act to further the purpose of NEPA.

G.1.2.12 DoD Directive 6050.9, Chlorofluorocarbons and Halons

DoD Directive 6050.9 requires that DoD establish procedures to eliminate the release of chlorofluorocarbons (CFCs) and halons into the atmosphere through the modification of operational, training, and testing procedures, and develop or adopt conservation practices such as recycling when appropriate and consistent with mission requirements, or develop alternative processes or suitable substitutes.

G.1.2.13 DoD Directive 6055.5, Industrial Hygiene and Occupational Health

DoD Directive 6055.5 requires that DoD provide each employee with a healthful workplace free from recognized chemical, physical, and biological hazards that could cause death or illness. This Directive establishes procedures to help identify, evaluate, and control health hazards and creates a surveillance program to ensure that the controls protect the health of DoD personnel.

G.1.2.14 DoD Directive 6055.8, Occupational Radiation Protection Program

DoD Directive 6055.8 requires that DoD reduce to a level as low as possible personnel exposure to radiation associated with DoD activities.

G.1.2.15 DoD Directive 6230.1, Safe Drinking Water

DoD Directive 6230.1 establishes the policy and procedures for the protection and enhancement of the quality of drinking water at all DoD-owned or -operated public water systems in the U.S. This Directive requires that all DoD water systems in the U.S. be constructed and maintained in a manner that provides the users with drinking water that meets the standards set forth by the National Primary Drinking Water Regulations, 40 CFR, Part 141, and by the regulations set forth by the U.S. EPA.

G.1.3 MILITARY STANDARDS

The following Military Standards were considered in the preparation of this PEIS.

G.1.3.1 Military Handbook 237A, Electromagnetic Compatibility Management Guide for Platforms, Systems, and Equipment

Military Handbook 237A provides guidance for establishing an effective electromagnetic compatibility program throughout the life cycle of military platforms, systems, and equipment. Deficiencies in design, management, planning, and control have led to reduced performance of military equipment due to the effects of electromagnetic energy. The handbook institutes procedures so that electromagnetic compatibility is a managerial consideration from concept development through production and deployment of military equipment and systems.

The electromagnetic compatibility program outlined by DoD emphasizes a number of basic principles. Primary among these are: early determination of electromagnetic compatibility requirements, achievement of total system electromagnetic compatibility in the operational environment, attainment of built-in electromagnetic compatibility in the design of electronic systems, assurance that electromagnetic compatibility can be achieved or duly considered, and establishment of control procedures to correct electromagnetic compatibility problems throughout the life cycle.

G.1.3.2 Military Handbook 419A, Grounding, Bonding, and Shielding for Electronic Equipment and Facilities

Military Handbook 419A provides basic and application information on grounding, bonding, and shielding practices recommended for electronic

equipment. It is intended to provide guidance to personnel concerned with the preparation of specifications and the procurement of electrical and electronic equipment for the Defense Communications System. The information provided primarily concerns grounding, bonding, and shielding of fixed plant telecommunications-electronics facilities. It also provides basic guidance in the grounding of deployed transportable communications/electronics equipment.

G.1.3.3 Military Standard 454N, Standard General Requirements for Electronic Equipment

Military Standard 454N covers the common requirements to be used in military specifications for electronic equipment. The standard is the technical baseline for the design and construction of electronic equipment for the DoD. It covers fundamental design requirements for general electronic specifications.

G.1.3.4 Military Standard 461B, Electromagnetic Emission and Susceptibility Requirements of Electromagnetic Interference

Military Standard 461B establishes the basis for evaluating electromagnetic characteristics, and it is intended to ensure that interference control is considered and incorporated into the design of equipment and subsystems. Military Standard 461B also establishes emissions and interference requirements for equipment and subsystems installed aboard aircraft, spacecraft and launched vehicles, in-ground facilities, surface ships, submarines, non-critical ground areas, special purpose and engine-driven vehicles, noninterruptible power sets, mobile electric power, equipment supply power to or used in critical areas, and commercial electric and electromechanical equipment.

G.1.3.5 Military Standard 462, Measurement of Electromagnetic Interference Characteristics

Military Standard 462 establishes techniques to be used for the measurement and determination of the electromagnetic interference characteristics (emission and susceptibility) of electrical, electronic, and electromechanical equipment.

G.1.3.6 Military Standard 469A, Radar Engineering Design Requirements, Electromagnetic Compatibility

Military Standard 469A establishes the engineering design requirements to control the electromagnetic emissions and susceptibility characteristics of all new military radar equipment and systems operating between 100 Megahertz and 100 Gigahertz. The engineering design requirements are also

intended to promote electromagnetic compatibility and conserve the frequency spectrum available to military radar systems.

G.1.3.7 Military Standard 810E, Environmental Test Methods and Engineering Guidelines

Military Standard 810E provides guidelines for conducting environmental engineering tasks to tailor environmental tests to end-item equipment applications. It also outlines test methods for determining the effects of natural and induced environments on equipment used in military applications. The test methods are intended to show deficiencies and defects and verify corrective actions, to assess equipment suitability for the environmental conditions anticipated throughout its life cycle, and to verify contractual compliance.

G.1.3.8 Military Standard 882A, System Safety Program Requirements

Military Standard 882A is intended to ensure that a safety program that stresses hazard identification and elimination is designed into DoD systems, subsystems, equipment, and facilities, including support, test, maintenance, and training equipment. Military Standard 882A provides the requirements for developing and implementing a safety system in which the objectives are consistent with mission requirements, identification, and elimination or control of hazards, and which considers safety, the ease of disposal, and the demilitarization of hazardous materials.

G.1.3.9 Military Standard 883D, Test Methods and Procedures for Microelectronics

Military Standard 883D establishes uniform methods, controls, and practices for designing, testing, identifying, and certifying microelectronic devices suitable for use within military and aerospace electronic systems. It includes procedures for basic environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding military and space operations, physical and electrical tests, design, package and material constraints, general marking requirements, and workmanship and training.

G.1.3.10 Military Standard 1472D, Human Engineering Design for Military Systems, Equipment, and Facilities

Military Standard 1472D establishes general human engineering criteria, principles, and practices for design and development of military systems, equipment, and facilities. Its purposes are to achieve required performance by operator, control, and maintenance personnel, to minimize skill and personnel requirements and training time, to achieve required reliability of

personnel-equipment combinations, and to foster design standardization within and among systems.

G.1.3.11 Military Standard 1541A, Electromagnetic Compatibility Requirements for Space Systems

Military Standard 1541A establishes the electromagnetic compatibility requirements for space systems. The purposes of the standard are to define minimum performance requirements for electromagnetic compatibility, define requirements for equipment and system tests, define analyses to demonstrate compliance with this standard, identify system relationships pertinent to electromagnetic compatibility, and identify requirements for equipment and system tests and define analyses to demonstrate compliance with this standard.

G.2 APPLICABILITY OF STATUTES AND ORDINANCES TO SPECIFIC ENVIRONMENTAL TOPICS

The following discussion addresses the applicability of Federal, state, and local statutes and ordinances to each of the 14 environmental topics for which environmental consequences are assessed in Chapter 4. Although the potential applicability of state and local statutes and ordinances is discussed in general terms, the discussion does not address any specific states or localities.

G.2.1 AIR QUALITY

G.2.1.1 Federally Regulated Issues and Concerns

Three sets of federal criteria regulating air quality and air emissions are established under the CAA (42 USC 7401 et seq.) and the CAAA. They include:

- National Ambient Air Quality Standards (NAAQS)
- Prevention of Significant Deterioration (PSD)
- National Emission Standards for Hazardous Air Pollutants (NESHAPs)

The NAAQS (40 CFR 50) set health-based air quality standards for six criteria pollutants that pose the greatest overall threat to air quality in the U.S. At the present time, the criteria pollutants are ozone, carbon monoxide, sulfur dioxide, lead, nitrogen dioxide, and particulate matter smaller than or equal to 10 microns. The PSD regulations (40 CFR 52) limit pollutant emissions from new sources and establish allowable pollutant increments (for the six criteria pollutants) for source modification. The

NESHAPs set air quality standards for eight of the 189 hazardous air pollutants (HAPs) addressed in the CAAA.

Constraints are placed on industries seeking to emit new or modified sources of criteria pollutants in nonattainment areas, and no major new source can be constructed without a permit. The permit imposes stringent control requirements on emissions. For areas that currently meet the NAAQS for criteria pollutants, new sources must not exceed the applicable PSD criteria.

Any new stationary source that will emit any of the eight pollutants regulated by the NESHAPs must also meet the NESHAP standards established for those pollutants. The U.S. EPA is in the process of establishing Maximum Achievable Control Technology standards for the 189 HAPs. Once the U.S. EPA imposes technology-based standards, it will consider the residual risks to the public.

All activities related to static testing and evaluation of individual components are considered stationary sources. For example, in-situ rocket motor testing and evaluation are considered stationary sources of emissions. However, the launching of rockets with the generation of an effluent plume is considered to be a mobile source. Section 173 of the CAAA allows emission increases from rocket engine and motor firing (and related cleaning operations) to be offset by alternative or innovative means at existing or modified major sources that test rocket motors or engines. For the offset to be allowed, the activity must be essential to national security.

G.2.1.2 Non-Federally Regulated Issues and Concerns

The primary issues and concerns pertaining to air quality are federally regulated. However, individual states or regional authorities may impose emission restrictions that are more stringent than the CAAA. Many states have established air quality standards for criteria pollutants that are more stringent than the NAAQS. Federal emissions criteria have been established for only eight HAPs, but many states have criteria for additional HAPs. If BMD activities are located in areas with state or local statutes that are more stringent than federal criteria, the state or local criteria must be followed.

The PSD and nonattainment guidelines have led to the concept of emissions trading in some states, whereby reductions in emissions generate emissions reduction credits that can be banked for later use or transferred to a third party.

Section 110 of the CAAA requires states to develop and submit State Implementation Plans to the U.S. EPA that outline measures for implementing, maintaining, and enforcing the NAAQS. Compliance with air pollutant emission regulations is enforced by state regulatory authorities,

which require that construction/operating permits be obtained for any new or modified facilities that emit regulated pollutants. Any BMD activity in a state with an approved State Implementation Plan would be subject to the air quality standards established by that state.

G.2.1.3 Non-Regulated Issues and Concerns

Although HAP emissions are federally regulated, specific NESHAPs have not yet been established for many of the 189 HAPs recognized under the CAAA. In the meantime, emissions of these HAPs constitute an important concern. NESHAPs for many of these HAPs will be issued by the U.S. EPA in the coming years. Many of the same compounds which cause stratospheric ozone depletion also have the potential to alter the global climate balance. Since the CAAA specifically seeks to reduce emissions of stratospheric ozone depletors, impacts to the global climate balance will also be reduced.

G.2.2 UPPER ATMOSPHERE

G.2.2.1 Federally Regulated Issues and Concerns

Title VI of the CAAA of 1990, entitled "Stratospheric Ozone Protection," lists specified ozone-depleting substances with their ozone-depletion potential, atmospheric lifetimes, and potential to change the global climate. The major focus of Title VI is to replace Class I and Class II substances with chemicals, product substitutes, or alternative manufacturing processes that reduce overall risks to the environment. Class I substances cause or substantially contribute to harmful effects of the stratospheric ozone layer. Class I substances include a number of chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform. Class II substances are known to cause or contribute to (or may reasonably be anticipated to cause or contribute to) harmful effects of the stratospheric ozone layer. Class II substances include compounds of hydrochlorofluorocarbons and their isomers. Title VI dictates that most production of Class I substances will be phased out by 1996. Exemptions may be granted to DoD if there is a national security need for a Class I substance with no alternative. For example, DoD is considering establishment of a "DoD Halon Bank" for the conservation and reuse of halons. Production of Class II substances will be phased out by 2030.

G.2.2.2 Non-Federally Regulated Issues and Concerns

The phaseout schedule for those substances listed in Title VI of the CAAA is determined by Congress and enforced by the U.S. EPA. However, states have the authority to accelerate phaseouts or strengthen restrictions on these substances through their individual State Implementation Plans.

Compliance with stricter standards established by states under the CAAA would constitute a non-federally regulated issue.

G.2.2.3 Non-Regulated Issues and Concerns

Class I and II ozone-depleting compounds released at ground level are now federally regulated. However, the currently unregulated use of rockets which deposit ozone-depleting compounds directly into the stratosphere will continue.

G.2.3 ELECTROMAGNETIC RADIATION

G.2.3.1 Federally Regulated Issues and Concerns

The Occupational Safety and Health Act (29 USC 651 et seq.) is intended to provide a safe and healthy working environment for every worker. Under the Act, employers must provide a workplace that is free from hazards that could cause either death or serious physical harm to employees. Under its authority, several standards have been implemented to deal with exposure to electromagnetic fields and EMR.

The U.S. Government controls the use of radio frequency EMR to reduce any interference between communication and other radio frequency systems. Civilian use of radio frequency EMR is under the control of the Federal Communications Commission. U.S. Government use is under the authority of the National Telecommunications and Information Administration (NTIA). DoD organizations seeking a radio frequency allocation apply to the parent agency frequency manager. Applications are generally sent to the DoD Electromagnetic Capability Analysis Center for coordination and to the NTIA for allocation.

G.2.3.2 Non-Federally Regulated Issues and Concerns

Many state and local safety and health standards are more restrictive than Occupational Safety and Health Administration (OSHA) standards. Some states have separate standards for EMR emissions which would apply to the BMD system components. For example, the Massachusetts Department of Public Health limits radio frequency EMR exposure to 1.0 thousandth of a watt per square centimeter (mW/cm^2), so any BMD activities located there would be required to comply with this standard. Compliance with stricter state or local EMR standards would constitute a non-federally regulated issue and concern.

G.2.3.3 Non-Regulated Issues and Concerns

Hazards of EMR to resources other than human safety would constitute non-regulated issues and concerns. Examples discussed in Section 3.3.2 include threats to biological resources and interference with other users of EMR.

G.2.4 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

G.2.4.1 Federally Regulated Issues and Concerns

RCRA (42 USC 6901 et seq.) regulates the handling and disposal of solid and hazardous wastes. RCRA is the 1976 amendment to the Solid Waste Disposal Act. Subsequent amendments to RCRA include the Hazardous and Solid Waste Amendments and the Federal Facility Compliance Act. Subtitle C of RCRA covers the management of hazardous waste. Subtitle D of RCRA covers the management of nonhazardous solid waste. Subtitle I of RCRA covers underground storage tanks containing petroleum and hazardous substances.

CERCLA (42 USC 9601 et seq.) establishes a national program to identify and clean up hazardous contamination associated with abandoned sites where hazardous substances may have been released to the environment. CERCLA was amended by SARA. Title III of SARA is the EPCRA. EPCRA requires facilities using or storing a hazardous substance, or toxic material to report certain information to various Government agencies. Section 103 of CERCLA includes requirements for reporting spills of hazardous substances to a National Response Center. Sections 104 and 105 of CERCLA authorize the development and implementation of a National Contingency Plan for the prevention of and immediate response to releases of hazardous substances to the environment. EPCRA requires facilities that possess, use, and release quantities of hazardous substances over threshold limits to report those quantities to regulators for public access.

HMTA (49 USC 1801 et seq.) authorizes the U.S. Department of Transportation (DOT) to create and enforce regulations regarding the transportation of hazardous materials. DOT coordinates with other federal agencies, including the U.S. EPA, in implementing programs under HMTA. Regulations under HMTA establish standards for packaging, labeling, documentation and manifesting, and materials classification.

The Pollution Prevention Act (42 USC 13101 et seq.) establishes a national policy of pollution prevention through source reduction or through recycling, treatment, and disposal. The Act calls for the establishment of a nationwide source-reduction program and a strategy for quantifying source-reduction efforts. DoD has incorporated this national policy into its acquisition programs. DoD Directive 4210.15, "Hazardous Materials Pollution Prevention," DoD Directive 5000.1, "Defense Acquisition System," and DoD

Instruction 5000.2, "Defense Acquisition System Procedures," establish specific pollution prevention guidelines which will be followed during the life of the BMD Program.

The Federal Facility Compliance Act (42 USC 6901 et seq.) gives any state that has an authorized hazardous waste program the authority to conduct an inspection of any hazardous facility, including federal facilities, for the purpose of enforcing compliance with the state's program. BMD facilities that handle hazardous waste would be subject to this Act.

Most state hazardous waste regulations have been federally authorized by the U.S. EPA under the authority of RCRA. These regulations can be stricter or broader in scope than federal regulations.

G.2.4.2 Non-Federally Regulated Issues and Concerns

Although all issues and concerns pertaining to hazardous materials and waste are federally regulated, states are authorized under RCRA to implement and enforce standards that meet or exceed federal standards. Many activities could therefore meet federal criteria established under RCRA but not stricter state criteria. Compliance with stricter state regulations may constitute a non-federally regulated issue and concern.

G.2.4.3 Non-Regulated Issues and Concerns

Although all issues and concerns pertaining to hazardous materials and waste are regulated, some materials are either not addressed by or are exempted specifically from RCRA. Although not regulated, use or generation of these materials could still be an important concern.

G.2.5 NOISE

G.2.5.1 Federally Regulated Issues and Concerns

The NCA (42 USC 4901 et seq.) and its amendment provide the basis for the U.S. EPA to encourage the development of state and local noise control programs, and direct federal agencies to comply with local community noise statutes. The NCA also directs federal agencies to carry out programs in a manner that minimizes noise impacts on public health and welfare. The NCA directs the U.S. EPA to develop sound-level guidelines for protection of public health and welfare for use by states and localities in developing noise control programs. Other federal agencies have developed community noise exposure guidelines including DOT, DoD, and the Department of Housing and Urban Development.

The U.S. EPA guideline recommends a day/night average sound level (DNL) of 55 decibels (dB), which is sufficient to protect the public from the effects

of broadband environmental noise in typically quiet outdoor and residential areas (U.S. EPA, 1974). The U.S. EPA guideline of DNL 55 dB is intended to protect against activity interference and annoyance. For protection against hearing loss in the general population from nonimpulsive noise, the U.S. EPA guideline recommends an equivalent sound level (L_{eq}) of 70 dB or less over a 40-year period.

The land use compatibility guidelines used as criteria under Air Force planning regulations (AFR 19-9) specify an outdoor DNL less than 65 dB as acceptable for all land uses (U.S. Air Force, 1978). Somewhat higher noise levels may be acceptable for residential areas, provided a proper degree of building noise insulation is included in the structures. Army Regulation AR 200-1 uses the DNL as a noise descriptor for environmental planning. Zones with a DNL less than 65 dB are classified as acceptable for noise-sensitive uses such as housing, schools, and medical facilities. Zones with a DNL between 65 and 70 dB are classified as normally unacceptable for such uses and zones with a DNL above 70 dB as unacceptable for these uses.

Under the Occupational Safety and Health Act (29 USC 651 et seq.), OSHA has the responsibility of establishing regulations to limit noise exposure of workers. Standards to protect employees from suffering hearing damage or loss stipulate that 8-hour averaged noise levels shall not exceed 90 decibels A-weighted (dBA) (dBA units are defined in Section 3.5.1). As the noise level increases, allowable exposure time decreases rapidly to a maximum exposure of 115 dBA over a 15-minute period. An upper limit of 140 dBA (peak sound level) is established by OSHA to protect against impulse or impact noises capable of inflicting instantaneous hearing damage (29 CFR 1910.95).

An effective hearing protection program must be administered whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA. Where noise exposure exceeds an 8-hour level of 90 dBA, protection against noise must be provided in the form of administrative or engineering controls (if feasible) or personal hearing protection equipment.

Similarly, occupational noise exposure is limited for Air Force activities to an 8-hour time-weighted average sound level of 85 dBA or equivalent level (AFOSHS 48-19). Above this limit, hearing protection is required. Exposure to impulsive sounds is limited to 140 dB peak sound-pressure level without hearing protection. Army regulations specify similar requirements for noise exposure and hearing protection.

G.2.5.2 Non-Federally Regulated Issues and Concerns

Many states and communities have developed community noise regulations or zoning ordinances which specify limits on noise. These regulations may limit specific noise sources or may specify limits on noise at property boundaries. Community noise limits are often based on 24-hour average levels, but may also be based on maximum noise levels or increases in noise above an existing background sound level. Some of these regulations have been created based on the U.S. EPA guidelines developed under the NCA.

The potential for noise effects on wildlife may be addressed by some state and local noise control ordinances. Noise can reduce the value of wildlife habitat and may interfere with the nesting and migration habits of some species.

G.2.5.3 Non-Regulated Issues and Concerns

Issues and concerns pertaining to noise are generally regulated under local ordinances. However, certain localities have not passed ordinances regulating noise. The issues and concerns pertaining to noise would be the same in those localities, but they would be non-regulated.

G.2.6 SAFETY

G.2.6.1 Federally Regulated Issues and Concerns

Several federal regulations and standards address the two categories of hazards—substances and physical agents—discussed in Section 3.6.2. The principal federal statute regulating the safety of workers and the public is the Occupational Safety and Health Act. Several other federal statutes also address safety.

The Act has developed standards to promote a safe working environment. The standards establish general environmental controls, including personal protective equipment wherever necessary by reason of hazards, process, or environment. Exposure limits for noise (Section 3.5), ionizing and non-ionizing radiation, and toxic and hazardous substances (Section 3.4) have been established as well as requirements for handling and storing compressed gases and flammable liquids. The Act also provides standards for emergency responses for hazardous chemicals and hazardous wastes.

HMTA (49 USC 1801 et seq.) is also a key consideration in the assessment of impacts to safety. HMTA is intended to protect the nation from risks to life and property associated with the transportation of hazardous materials in commerce. The transportation of hazardous materials is subject to transportation regulations, including handling, labeling, and routing requirements.

TSCA (15 USC 2601 et seq.) regulates toxic substances, including polychlorinated biphenyls, in various applications. TSCA requires testing and notifications for new substances or substantial new uses of existing substances, imposes specific controls on the handling of certain hazardous materials, and requires record keeping and reporting.

The Radiation Control for Health and Safety Act (42 USC 263b et seq.) provides for the protection of public health from radiation emissions of electronic products. Provisions of the Act call for minimizing the emissions from, and the exposure of the public to, unnecessary electronic product radiation. This Act encompasses television, microwave, x-ray, accelerator, and laser products, as well as products generating intense magnetic fields. While primarily a concern for the original seller of the products, the potential for BMD Program liability for excessive radiation levels from salvaged products resold to the public may be a concern.

The Food and Drug Administration performance standards for lasers (21 CFR 1040.10 - 1040.11) are based on preventing damage to the eye. All lasers must meet the FDA's Laser Performance Standard, which is based on the American National Standards Institute Z136.1, "Standard for Safe Use of Lasers." Lasers are classed according to their potential for damage to the eye, and range from Class I (lasers capable of producing no biological damage: less than 0.39 microwatt of continuous output) to Class IV (high-intensity lasers capable of causing biological damage: greater than 0.5 watt of continuous output). High-intensity lasers are capable of inflicting injury even when the beam is scattered or diffused by a rough surface or a smoke screen.

American National Standards Institute Z136.1 requires the use of engineering controls for Class IV lasers. However, adherence to the American National Standards Institute standards does not always guarantee protection from lasers. There are examples of permanent retinal damage from exposures to lower powered lasers. Appropriate administrative controls (e.g., eye protection, warning signs) and engineering controls (e.g., door locking mechanisms) can be used to warn personnel and protect them from damaging exposure to high-powered lasers. DoD Instruction 6050.6, "Exemption for Military Laser Products," provides certain exemptions for military laser products.

Several DoD documents in the "6055" series deal with safety issues and would be invoked where appropriate through facility Standard Operating Procedures to comply with federal laws and regulations. Among those relevant to BMD Program activities are the following:

- DoDI 6055.1, DoD Occupational Safety and Health Program
- DoDI 6055.5, Industrial Hygiene and Occupational Health

- DoDI 6055.6, DoD Fire Protection Program

- DoDI 6055.7, Mishap Investigation, Reporting, and Record keeping

- DoDI 6055.8, Occupational Radiation Protection Program

- DoDD 6055.9, The DoD Explosives Safety Board

- DoDI 6055.11, Protection of DoD Personnel from Exposure to Radiofrequency Radiation

- DoDI 6055.12, DoD Hearing Conservation Program

- DoDD 6055.13, Transportation Accident Prevention and Emergency Response Involving Conventional DoD Munitions and Explosives

G.2.6.2 Non-Federally Regulated Issues and Concerns

Many state statutes and local ordinances establish stricter safety requirements and are more comprehensive than federal statutes. Compliance with stricter state or local standards would constitute a non-federally regulated issue and concern.

In addition, to ensure that personnel safety within the BMD Program is addressed adequately, a Global Protection Against Limited Strikes System Safety Guide (SDIO, 1993) has been issued. This document, while not a federal regulation, provides guidance for establishing, developing, and implementing a comprehensive System Safety Program. It is intended as guidance for all BMDO activities.

G.2.6.3 Non-Regulated Issues and Concerns

Although impacts related to safety are being considered as federally regulated, for the purposes of this PEIS several safety issues do not fall under the purview of OSHA or the other federal regulations outlined in Section G.1. Examples include new and exotic substances, agents, and materials for which regulations have not been promulgated. Potential debris hazards to personnel from abnormal launch sequences are not covered under federal regulations. Such hazards would be minimized by rigorous application of existing range safety and downrange flight restrictions.

G.2.7 SURFACE WATER

G.2.7.1 Federally Regulated Issues and Concerns

The CWA (33 USC 1251 et seq.), as amended by the Water Quality Act of 1987, is designed to restore and maintain the chemical, physical, and biological integrity of surface waters. Section 402 of the CWA establishes the NPDES, under which permits are required for point source discharges to surface waters. NPDES permits are also required for certain nonpoint discharges such as stormwater runoff from industrial sites. BMD activities that generate regulated discharges would have to discharge under existing NPDES permits or obtain new or revised permits.

Section 404 of the CWA establishes a permitting system for the discharge of dredged or fill material to surface waters. Before a Section 404 Permit can be issued, a Water Quality Certification must be issued certifying that the discharged material would not adversely impact surface water quality. Additionally, discharges of dredged or fill material must meet the Section 404 (b)(1) Guidelines, a series of technical criteria designed to protect the physical and biological integrity of surface water bodies.

The Oil Pollution Prevention Regulations (40 CFR 112), issued under Section 311 of the CWA, as amended by the Oil Pollution Act, require the preparation of Spill Prevention Control and Countermeasures (SPCC) plans to prevent the accidental release of oil into surface waters or onto adjoining shorelines. Most SPCC plans also include best management practices designed to prevent the accidental release of other hazardous substances.

The Marine Protection, Research, and Sanctuaries Act (33 USC 1401 et seq.) requires permits from the U.S. EPA for dumping any material, including wrecked or discarded equipment, into the ocean.

Executive Order 11988 requires federal agencies to consider the potential effects of flood hazards and floodplain management for any federal action that takes place in a floodplain. In general, activities involving the permanent modification of a floodplain would require a detailed impact assessment. Minor or temporary encroachment into floodplains would generally not require a detailed impact assessment.

Several other federal regulations that do not specifically address surface waters still indirectly regulate activities affecting surface waters. These include RCRA (42 USC 6902 et seq.), TSCA (15 USC 2601 et seq.), SDWA (42 USC 300 et seq.), the Rivers and Harbors Appropriations Act (33 USC 401 et seq.), the Coastal Zone Management Act (16 USC 1451 et seq.), ESA (16 USC 1531 et seq.), Executive Order 11990 (Protection of Wetlands), and the Fish and Wildlife Coordination Act (16 USC 661 et seq.).

G.2.7.2 Non-Federally Regulated Issues and Concerns

As provided in Section 402 of the CWA, many states have assumed responsibility for administering the NPDES and for issuing NPDES Permits. Effluent limitations are generally stricter on state-issued NPDES Permits than on federal permits. Some states have also enacted sediment control statutes that require the approval of soil erosion and sediment control plans for any construction activities involving the disturbance of a specified area of the soil surface. Many state sediment control statutes are administered by localities, and many localities in states lacking a sediment control statute have enacted local sediment control ordinances. Most states regulate withdrawals from surface waters and consider the impacts from reduced in-stream flow rates and reduced lake volumes before issuing permits authorizing withdrawals. In addition to the floodplain protection under Executive Order 11988, many states have enacted floodplain protection statutes, and many localities consider impacts to floodplains when deciding upon building permit applications.

G.2.7.3 Non-Regulated Issues and Concerns

Issues and concerns regarding surface water quality are generally federally regulated, and issues regarding surface water quantity are state-regulated. Floodplain issues and concerns are federally regulated.

G.2.8 GROUNDWATER

G.2.8.1 Federally Regulated Issues and Concerns

The SDWA (42 USC 300 et seq.) is designed to protect drinking water supplies and public water distribution systems. Under the Underground Injection Control Program, permits are required from the U.S. EPA for the underground injection of wastes. Federally funded projects which take place in Critical Aquifer Protection Areas designated under the SDWA are subject to special U.S. EPA review to ensure that no substantial threat to the aquifer occurs.

RCRA (42 USC 6901 et seq.) is also a key consideration in the assessment of impacts to groundwater. Because spills and leaks of hazardous waste represent a major source of groundwater contamination, noncompliance with RCRA can result in impacts to groundwater quality.

Several other federal regulations relating to the management of hazardous and toxic materials also indirectly regulate activities affecting groundwater. These include CERCLA (42 USC 9601 et seq.) and TSCA (15 USC 2601 et seq.).

G.2.8.2 Non-Federally Regulated Issues and Concerns

Many states have assumed responsibility for administering all or part of SDWA, RCRA, and the other federal statutes discussed above. The criteria for compliance under the state-administered programs may be stricter than those established under the federal statutes. Most states also require permits for the appropriation or withdrawal of groundwater.

G.2.8.3 Non-Regulated Issues and Concerns

Impacts to groundwater quality are principally federally regulated, and impacts to groundwater quantity are regulated principally at the state or local level.

G.2.9 VISUAL RESOURCES

G.2.9.1 Federally Regulated Issues and Concerns

The visual quality of many areas is protected indirectly by regulations under a variety of statutes. For example, the Federal Land Policy and Management Act (43 USC 1701) establishes a federal policy that public lands are to be managed in a manner that protects scenic values. The Wild and Scenic Rivers Act (16 USC 1271) establishes a federal policy to protect specific rivers of remarkable scenic quality. The CAAA (42 USC 7401 et seq.) establishes a policy that air quality impacts from new sources on visibility in Class I areas (natural parks and wilderness areas) must be assessed. Certain cultural resources protected under the federal regulations discussed in Section G.2.10 contribute to the visual quality of their surroundings.

G.2.9.2 Non-Federally Regulated Issues and Concerns

Impacts to visual resources are principally regulated under local zoning and other ordinances. In addition, many state and local governments have applicable regulations. For example, many state governments regulate the quality of visual resources within their coastal zones. Local zoning ordinances often regulate the appearance of structures, requiring, for example, that buildings in a historic area be constructed using certain materials or painted a particular color. This ensures that a historic area maintains its visual quality.

G.2.9.3 Non-Regulated Issues and Concerns

The analysis of potential impacts to visual resources in future environmental documentation would require evaluation of the surrounding environment. Visual quality is subjective, and a site could be visually pleasing to one person but not to another. However, with public involvement and the use

of an appropriate visual resource methodology, individual differences could be assessed and common values established. For example, in a mountainous area, a view of the mountains might seem to be unimportant. But a view of a particular mountain range from the valley might be very important to the local population and must therefore be a part of the impact analysis at the site-specific level.

G.2.10 CULTURAL RESOURCES AND NATIVE POPULATIONS

G.2.10.1 Federally Regulated Issues and Concerns

Impacts to certain paleontological features are regulated under the Antiquities Act (16 USC 431, 432, and 433).

NHPA, as amended in 1992 (16 USC 470), is the key federal statute regulating the identification and protection of cultural resources. NHPA established the NRHP, the responsibilities of the SHPO, and the Section 106 review and compliance process. NRHP maintains an inventory of qualifying cultural resources. The responsibilities of the SHPO include participation in the review of proposed federal actions that affect cultural resources. Section 106 is a procedural requirement whereby federal agencies must consider the effects of potential actions on cultural resources which are eligible for listing on NRHP.

The NRHP includes properties which are important at the national, state, and local levels. Therefore, a cultural or Native American resource need not be nationally important to be eligible for federal protection. The regulations which protect properties listed on NRHP also extend to those properties which are eligible for listing.

The 1992 Amendment to the NHPA (also known as the Fowler Amendment) strengthens the role of tribal preservation officers in the national preservation program and explicitly acknowledges the preservation interests of Native Americans.

AIRFA (42 USC 1996 et seq.) recognizes and protects the religious freedoms of Native Americans as an integral part of their culture, tradition, and heritage. AIRFA preserves the right of access by Native Americans to sacred sites, including cemeteries; to use and possess sacred objects; and to freely worship through ceremonial and traditional rites.

NAGPRA (25 USC 3001 et seq.) establishes federal policy addressing the rights of Native Americans to possess certain human remains and cultural items. NAGPRA applies to any intentional archaeological excavation, or inadvertent discovery of human remains and associated objects, which occurs on federal land. Prior to excavation (or upon inadvertent discovery),

the affiliated tribe(s) must be consulted to ensure the appropriate disposition of, and control over, the human remains and associated objects.

G.2.10.2 Non-Federally Regulated Issues and Concerns

The NHPA authorizes states to create preservation agencies and to establish state programs headed by an SHPO. In addition, state and local governments may maintain an inventory of cultural resources similar to NRHP and may nominate cultural and Native American resources to NRHP. State and local governments also participate in the protection of cultural resources through zoning and the establishment of historic districts.

G.2.10.3 Non-Regulated Issues and Concerns

Prehistoric, historic, and Native American resources which contribute to the broad and diverse category of history and culture are eligible for protection under federal, state, or local regulations.

G.2.11 BIOLOGICAL RESOURCES AND WETLANDS

G.2.11.1 Federally Regulated Issues and Concerns

The ESA (16 USC 1531 et seq.) is intended to prevent the further decline of endangered and threatened species of animals and plants and to restore those species and their habitats. The definitions of threatened and endangered, as established under the ESA, are provided in Section 3.11.1. If contact with the U.S. FWS or National Marine Fisheries Service (NMFS) indicates a listed species could be present on a proposed project site or might otherwise be affected, it is the responsibility of the sponsoring federal agency to prepare a biological assessment. If the assessment determines that a species would be affected, under Section 7 of the ESA, the sponsoring federal agency must formally consult with the U.S. FWS and/or the NMFS prior to sponsoring, funding, or permitting an action. Formal consultation could lead to project modification or the adoption of mitigation measures to ensure protection of the listed species.

Section 404 of the CWA (33 USC 1251 et seq.) prohibits the discharge of dredged or fill material into waters of the U.S. (a term that includes wetlands) without a permit from the U.S. COE. The U.S. EPA has veto authority over permitting decisions made by the U.S. COE. The criteria used to evaluate applications for Section 404 permits are established in Section 404(b)(1) guidelines of the CWA. A number of Nationwide General Permits (33 CFR 330) have been established by the U.S. COE that authorize certain minor or routine activities if specified conditions are met.

Section 316(a) of the CWA regulates the effluent limitations of thermal discharges in order to ensure protection and propagation of balanced

indigenous populations of shellfish, fish, and wildlife. Section 316(b) regulates the entrainment and impingement of aquatic biota (whereby aquatic organisms are either carried into water intake pipelines or trapped against intake screens).

Executive Order 11990 requires all federal agencies to consider protection of wetlands in the decision-making process for any action. Unlike Section 404 of the CWA, Executive Order 11990 regulates all types of impacts to wetlands including clearing and draining, in addition to the discharge of dredged or fill material.

The Migratory Bird Treaty Act (16 USC 703 et seq.) is intended to protect migratory birds that are included in several international conventions between the U.S. and Canada, Mexico, Japan, and the former Union of Soviet Socialist Republics. The Act prohibits the killing of migratory birds or destruction of their nests or eggs.

Other federal statutes protecting biological resources include the Bald and Golden Eagle Protection Act (16 USC 688 et seq.), the Anadromous Fish Conservation Act (16 USC 757a et seq.), the Marine Mammal Protection Act (16 USC 1361 et seq.), and the Marine Protection Research and Sanctuaries Act (33 USC 1401 et seq.).

G.2.11.2 Non-Federally Regulated Issues and Concerns

Most states have passed statutes similar to the ESA and maintain their own lists of threatened and endangered species. The state lists usually contain more species than are listed under the ESA, including species whose continued existence in the state (but not necessarily in the entire U.S.) is jeopardized. Natural Heritage Program offices have been established in most states to track and inventory plants on both the federal and state lists. The degree to which states protect species on their state lists varies widely.

One state, Michigan, has assumed responsibility for permitting the discharge of dredged or fill material into some types of wetlands under Section 404 of the CWA. Many other states have established wetland protection statutes that are completely independent of the CWA. Regulations under the state statutes vary widely in their degree of wetland protection. In contrast to Section 404 of the CWA, many state regulations apply to the clearing and draining of wetlands instead of just to the discharge of dredged or fill material. Buffer zones in upland areas surrounding wetlands are also protected under the wetland protection regulations of several states.

Some states and local jurisdictions have adopted a wide variety of other regulations protecting certain biological resources. For example, states may have special protection measures for migratory birds and raptors. Many local jurisdictions have tree ordinances requiring developers of wooded sites

to inventory trees, minimize their removal, and compensate for their loss by planting replacements.

G.2.11.3 Non-Regulated Issues and Concerns

Most of the issues and concerns discussed in Section 3.11.2 pertaining to biological resources other than threatened or endangered species, wetlands, or migratory birds are non-regulated.

G.2.12 LAND USE

G.2.12.1 Federally Regulated Issues and Concerns

The issues and concerns addressed in Section 3.12.2 pertaining to land use are principally regulated by state, regional, and local governments. Executive Order 12372, Intergovernmental Review of Federal Programs, indirectly requires federal land use decisions to be compatible with local standards. Furthermore, land use decisions affecting federally owned lands such as National Parks, Forests, Seashores, Wild and Scenic Rivers and Wilderness Areas are federally regulated.

Executive Order 12372 directs federal agencies to consult with and solicit comments from state and local government officials whose jurisdictions would be affected by federal development.

G.2.12.2 Non-Federally Regulated Issues and Concerns

Many counties, townships, incorporated cities, and other local jurisdictions have enacted zoning ordinances in which permitted land uses are specified for each tract of land within the jurisdiction. Although zoning ordinances are legally enforceable and serve to limit land use options, landowners frequently request and obtain zoning reclassification allowing previously unpermitted land uses, or zoning variances allowing minor exceptions to zoning limitations. Land use regulations implemented under zoning ordinances vary in breadth according to the particular land use activities and the importance that each jurisdiction places on the management of its resources and the development of its communities. Many jurisdictions, including those without zoning ordinances, have developed Comprehensive Plans or Master Plans. These plans outline land development objectives that are favored by local planning officials but are not legally enforceable.

G.2.12.3 Non-Regulated Issues and Concerns

Although increasingly uncommon, some local jurisdictions (especially rural jurisdictions) have not enacted zoning ordinances and do not otherwise regulate land use. Furthermore, there is considerable latitude in land use

options under most local regulations that could allow land use conflicts to arise.

G.2.13 SOCIOECONOMICS

G.2.13.1 Federally Regulated Issues and Concerns

None of the issues and concerns discussed in Section 3.13.2 pertaining to socioeconomic is federally regulated.

G.2.13.2 Non-Federally Regulated Issues and Concerns

In general, the issues and concerns discussed in Section 3.13.2 are not regulated by any level of government. However, certain local laws and regulations can affect the social and economic conditions of an area. For example, many local zoning ordinances determine the density of housing or commercial development permissible in a given area. This, in turn, could determine the pattern and extent of BMD Program-related growth.

G.2.13.3 Non-Regulated Issues and Concerns

Most of the issues and concerns discussed in Section 3.13.2 are non-regulated.

G.2.14 GEOLOGY, SOILS, AND PRIME AND UNIQUE FARMLAND

G.2.14.1 Federally Regulated Issues and Concerns

The extraction of mineral deposits, including deposits of strategic or economically important resources, may be protected by mineral and geologic rights under federal law. Impacts to mineral resources are regulated through the Public Buildings, Property and Works Act, which is known as the Engle Act (43 USC 158 et seq.), and its incorporation of the Bureau of Land Management mineral management regulations at 43 CFR 3000 et seq. In addition, sections of the Geothermal Steam Act regulate geothermal development. Activities which may cause destruction or disturbance of unique and irreplaceable geologic features are subject to scrutiny under federal regulations. Unique geologic features are given some protection by the Federal Caves Protection Act.

Issues and concerns discussed in Section 3.14.2 pertaining to soils are regulated primarily under state statutes and local ordinances. However, the Soil Conservation and Domestic Allotment Act (16 USC 590a et seq.) requires the control and prevention of potential soil erosion caused by federal activities and projects. The issues and concerns pertaining to prime and unique farmland are federally regulated.

The Public Buildings, Property and Works Act states that all minerals, including oil and gas, in DoD lands are under the jurisdiction of the Secretary of the Interior and applicable public land mining and mineral leasing laws. Mineral resources on DoD lands can be developed, but only if the Secretary of Defense determines that the development is consistent with the military uses of the land. The Mineral Leasing Act for Acquired Lands (30 USC 352) describes restrictions similar to those found at 43 USC 158.

The Geothermal Steam Act (30 USC 1002 et seq.) states that the Secretary of the Interior may issue leases for the development of geothermal resources in lands administered by the U.S. DOI, including public, withdrawn, and acquired lands. This includes lands withdrawn for use by DoD.

The Federal Caves Resources Protection Act (16 USC 4301) states that it is the policy of the U.S. that federal lands be managed in a manner which protects and maintains, to the extent practical, caves. The term "federal lands" means lands whose fee title is owned by the U.S. and administered by the Secretary of Agriculture or the Secretary of Interior.

The purpose of the Earthquake Hazards Reduction Act (42 USC 7701 et seq.) is to reduce the risk to life and property from future earthquakes through the establishment and maintenance of an effective earthquake hazards reduction program. The objectives of the program include: 1) earthquake-resistant construction; 2) earthquake prediction; 3) development of model building codes; 4) understanding of earthquake-related issues; 5) public education; 6) research into earthquake mitigation, consequences of earthquake prediction, and earthquake insurance; and 7) research into control or alteration of seismic phenomena. DoD is one of the many U.S. Government agencies participating in this program.

The Soil Conservation and Domestic Allotment Act (16 USC 590a et seq.) is intended to preserve and protect a variety of natural resources (such as navigable waterways and land), man-built structures (such as reservoirs), and public health by controlling and preventing soil erosion on public lands.

The FPPA (7 USC 4201 et seq.) is intended to reduce the conversion of farmland to nonagricultural uses by federal projects and programs. The FPPA requires that federal projects and programs comply with state and local government policies and regulations to preserve farmland. Federal agencies typically consult with the U.S. Soil Conservation Service (SCS) to determine if prime or unique farmlands are present in the affected area.

G.2.14.2 Non-Federally Regulated Issues and Concerns

Many states and localities require the approval of soil erosion and sediment control plans prior to permitting ground disturbances over a certain area (typically 465 square meters [5,000 square feet]). The purpose of the plan is to outline mitigation measures that prevent excessive soil erosion and consequent sedimentation of nearby surface water bodies. Some localities discourage ground disturbance of slopes greater than a certain grade.

G.2.14.3 Non-Regulated Issues and Concerns

The quality of soils for growing crops and other plant-growing activities can be irreversibly reduced when the topsoil and other fertile surface horizons are mixed with more sterile subsoil horizons. Land subsidence can occur when fluids are removed from porous underground rocks and sediments, causing these materials to compact and the ground to settle. Sinkholes, which area created by land subsidence, are also thought to be triggered by fluctuations in water tables. Both forms of subsidence can cause substantial damage to structures and infrastructure.

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Appendix H

APPENDIX H

ORBITAL DEBRIS

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ORBITAL DEBRIS

Orbital debris (all earth-orbiting objects except active satellites) does not generally affect the human environment. Consequently, analysis of potential effects of orbital debris generated by National Missile Defense (NMD) activities is not considered part of the issues and concerns of this Programmatic Environmental Impact Statement (PEIS). Nevertheless, the problems of orbital debris are considered important by the Department of Defense (DoD) and are discussed below.

H.1 BACKGROUND DISCUSSION ON ORBITAL DEBRIS

H.1.1 DEFINITION OF TOPIC

Orbital debris refers to all earth-orbiting objects except active satellites. Such objects include:

- Particles from exploded or fragmented satellites or transfer vehicles. Explosion/fragmentation can occur as a result of propulsion-related failure, deliberate destruction, or collision.

- Inactive satellites. Spacecraft typically remain in orbit beyond their useful lives.

- Spent rockets. Some rockets and rocket boosters which deliver spacecraft into orbit also end up in orbit.

- Operational debris. Debris such as paint flakes and particles from thermal insulation are released into space during space operations. Miscellaneous hardware is ejected when spacecraft stages are separated by explosive devices.

- Propellant by-products. Small particles of aluminum oxide are placed in orbit by the exhaust of solid-fuel rockets (USOTA, 1985).

H.1.2 ISSUES AND CONCERNS

Orbital debris poses a problem because it can interfere with activities in space. Collision is the primary hazard that orbital debris poses to functioning spacecraft. Also, the gases and particles created by exhaust clouds can erode surfaces and/or contaminate spacecraft. In addition, debris can interfere with scientific missions by complicating the work of astronomers, disrupting radio telescope reception, and distorting photographs.

Debris can damage and destroy operating payloads; and, although with low probability, reentry debris could have an adverse effect on the environment. Specific concerns include:

- Generation of debris from operational activity. Design and procedural practices can minimize, but not eliminate, operational debris.

- Generation of debris from collisions of inactive satellites in crowded orbits. Removal of satellites eliminates the risk of collision-induced fragmentation and debris proliferation. At the end of their useful lives, satellites can be boosted into less crowded "parking" orbits or back into the earth's atmosphere for burn-up or recovery.

- Hazards posed by payloads and debris as they reenter the earth's atmosphere. The heat caused by friction in the atmosphere causes most debris to burn up before it reaches the earth's surface. However, some debris may survive the reentry process.

- Collisions between operational satellites and existing debris. Such collisions not only are a risk to the mission performance of the satellite, but also can create additional debris through fragmentation.

Orbital debris is addressed under international treaty. Title IX of the Outer Space Treaty of 1967 directs participating nations to conduct outer space activities with due regard to the interests of all nations involved in the treaty. The Liability Convention of 1972 holds nations liable for the damage that their space objects cause. It is recognized that enforcement of these treaties is difficult because it is difficult to trace the origin of offensive orbiting debris.

The United States recognizes the potential for orbital debris to cause impacts on the use of space. In 1987, DoD adopted a policy which states, "DoD will seek to minimize the impact of space debris on its military operations" (Interagency Group, 1989). Further, Air Force Consolidated Space Test Center Regulation 127-1 directs all Government agencies conducting tests in earth orbit to comply with a variety of procedures to minimize debris generation.

Orbital debris does not generally affect the human environment. There is the potential that orbital debris could adversely affect the human environment, such as deorbiting debris contributing to the contamination of pollutants. The effects of orbital debris are being studied by the Interagency Group for Space on Orbital Debris (Interagency Group, 1989). The results of the studies will be incorporated in future environmental documentation.

There exists the potential for orbital debris to survive the reentry process (i.e., not burn up before reaching the earth's surface). Identified reentry debris has included such diverse items as tank pieces, nozzle pieces, small spherical gas tanks, plastic shrouds, and other fragments. Reentry occurs when an orbiting spacecraft comes back into the earth's atmosphere. Any object placed in earth orbit will eventually deorbit and reenter the atmosphere; this includes launch and breakup debris of satellites and spent rocket stages. Spacecraft tend to spiral slowly toward the earth's surface. When objects reenter the atmosphere, their orbits decay rapidly and many of them burn up prior to impacting the earth's surface (U.S. DOT, 1988).

Material or objects which are not designed to survive reentry generally do not have ablative (vaporizable) surfaces, nor are they very stable aerodynamically. The usual sequence of events in the reentry process is as follows (U.S. DOT, 1988).

1. As the debris starts to reenter, heat is generated by the shock wave and a portion is absorbed by the surface of the object. As the object heats up, thermal energy is radiated out at a significantly lower rate than it is being absorbed.

2. The heated structure weakens, and when the aerodynamic forces exceed its structural strength, it starts to come apart.

3. The heating process continues on the remaining parts of the structure, repeatedly breaking it up into still smaller pieces.

4. These structural pieces continue to heat up, and eventually melt and vaporize if there is sufficient temperature and time exposure. Some structural elements can survive if they are massive or were shielded from the heat by other parts of the structure.

Surface heating effects depend on the object's shape, composition, altitude and velocity. For reentry at small angles of inclination, where the vehicle deceleration rate is small, the surface heating rate is correspondingly small. For reentry at large angles of inclination, where the vehicle decelerates rapidly in the atmosphere, the surface heating rate will be greater, but the time spent in the atmosphere will be shorter (U.S. DOT, 1988).

After the atmospheric reentry point has been predicted, various other conditions must be taken into account to predict a ground impact point. Some of these conditions include orbital corrections due to frictional heating, breakup due to atmospheric shock, drag, and prevailing meteorological conditions. All of these factors are important when assessing the hazards from reentering objects to people and property (U.S. DOT, 1988).

H.1.3 RANGE OF CONDITIONS

The U.S. Space Command has cataloged and currently tracks about 7,000 objects greater than 10 centimeters (3.9 inches) in diameter. Objects smaller than this cannot be tracked with current technology. These 7,000 objects account for more than 99 percent of the total debris mass but only about 0.2 percent of the total number of objects. It is estimated that there are about 17,500 objects 1-10 centimeters (0.4-3.9 inches) in diameter and several million 0.1-1 centimeter (0.04-0.4 inch) in diameter. Objects between 1 and 10 centimeters (0.4 and 3.9 inches) are of particular concern because they are capable of causing catastrophic damage. Shielding techniques are ineffective against debris greater than 1 centimeter (0.4 inch) in diameter.

The probability that a space vehicle will collide with debris varies according to where the vehicle is positioned. Debris density varies with orbital altitude and inclination, and tends to be greatest in the most frequently used orbits. Low-earth orbits are those less than about 5,500 kilometers (3,410 miles) in altitude with orbital periods of less than 225 minutes. These are the most used orbits and have the greatest debris densities. Also of concern are geosynchronous earth orbits (GEO), which are at about 36,000 kilometers (22,320 miles) in altitude, where orbital periods are 24 hours. These orbits are used extensively for communications satellites.

H.2 POTENTIAL EFFECTS OF ORBITAL DEBRIS

H.2.1 PREFERRED ACTION (TECHNOLOGY READINESS PROGRAM)

H.2.1.1 Potential Effects of Orbital Debris

Orbital debris can interfere with activities in space, primarily by colliding with operational satellites. Testing in space of space-based elements in the Preferred Action would contribute to the satellite population. NMD test elements would be vulnerable to debris and would themselves be potential debris sources. Potential generation of orbital debris during the early- and mid-term time frames of the Technology and Readiness Program would be small relative to that occurring during objective system activities. However, even objective system activities would represent a very minor potential source of debris compared to other ongoing space missions.

It is not possible at this time to precisely assess potential impacts of NMD activities with respect to orbital debris. The exact number of launches and required satellites would not be known until a later stage of engineering. The altitude and inclination at which satellites would orbit the earth has not yet been determined. Orbital debris is not uniformly distributed in space, and debris density varies with orbital altitude and inclination. More

quantitative assessments of orbital debris impacts would be included as necessary in future environmental documentation.

Mathematical models, such as IMPACT and DEBRIS (Chobotov, 1990), have been developed to describe current and future debris environments and predict collision probabilities. These models have a number of limitations. It is difficult to validate models through empirical data because current technology does not allow debris less than 10 centimeters (3.9 inches) in diameter to be identified. Some 99 percent of debris is smaller than this. In addition to measurement uncertainty, there is uncertainty as to the level of future space activity, and therefore the rate at which debris will proliferate. Lastly, collision probability also depends on the size of the target object.

Regarding impacts from reentry, most satellites to date have been placed into orbit with little or no consideration given to their eventual reentry. The primary reason for this is that reentering objects are not likely to result in hazardous impacts, given that two thirds of the earth's surface is covered by oceans. Most of the objects which reenter are likely to fragment and burn up in the upper atmosphere and make only negligible changes in its chemical composition. Even if an object does survive, only one third of the earth is land area, and only a small portion of this land area is densely populated, so the chance of hitting a populated land area upon reentry is small (U.S. DOT, 1988).

Consider the following sample of historical early launch vehicle reentry statistics. According to NASA records on the Delta vehicle launch performance and failure history, out of 12 failures experienced in 25 years in over 180 launches, only 4 required destruct actions by Range Safety, and only 1 involved reentry of fragments with land impact with no damage reports, although 5 led to reentry of spacecraft stages and debris. Early launch vehicle reliability figures are only a very rough guide to the potential for adverse public impacts of launch failures, because only a small fraction of these has the potential to inflict public property damage and injuries (U.S. DOT, 1988).

There is no standard way of computing impact dispersions currently. The calculations are twofold. Estimates must be made for the number of pieces which will survive reentry and the area over which each piece could cause damage—the "casualty area" (U.S. DOT, 1988). These types of calculations, in addition to risk assessments, will be considered at the program-specific level of environmental documentation.

H.2.1.2 Methods to Reduce the Generation of Orbital Debris

Methods to reduce the potential generation of orbital debris fall into three basic categories: generation reduction, collision avoidance, and spacecraft protection. Examples include:

- Designing spacecraft so that it resists environmental degradation while in space.
- Devising procedures which limit the spread of operational debris from the separation of spacecraft and upper rocket stage. Disposing of expendable hardware at the lowest possible altitude could reduce the risks from debris by allowing orbital decay and eventual reentry to occur more quickly.
- Refraining from deliberately fragmenting inactive satellites. The former Soviet Union commonly provided for disassembly of nuclear reactors on reconnaissance satellites at the end of their mission life. The high-density fuel rods have longer orbital lifetimes than the spacecraft itself, so this practice allowed for maximum decay of radioactive materials prior to reentry.
- Developing cleaner propellants to reduce the emissions of aluminum oxide particulates, which is one form of orbital debris (USOTA, 1985).

Collisions are generally avoided by selecting orbits with low debris densities and by removing satellites from crowded orbits when they are no longer mission capable. Orbital lifetimes increase dramatically up to about 800 kilometers (467 miles) altitude, above which they are virtually infinite. It should also be noted that atmospheric drag will cause objects in low-elevation orbits to eventually reenter the earth's atmosphere. Therefore, debris can be removed by ensuring that debris-generating activities take place at very low altitudes where natural forces cause debris to burn up during reentry.

Additional methods to reduce the potential generation of orbital debris could include:

- Planned reentry of spacecraft and upper stages into the earth's atmosphere. Spacecraft in low and medium orbits and upper stages could be deorbited by reserving extra fuel or adding a propulsive device specifically for this purpose. However, this option could involve additional cost and reduced performance associated with the added weight. Most debris vaporizes upon reentry, but some objects could survive reentry and cause environmental damage at the earth's surface.

- Disposal of inactive payloads into parking orbits (little-used orbits where the likelihood and importance of debris-generating collisions are reduced). This practice could also involve a performance cost. It is estimated that raising satellites to an acceptable level beyond GEO requires the same amount of fuel as is required to keep the satellite in orbit for an additional year (Interagency Group, 1989).

- The use of specially dedicated spacecraft to remove debris. Cost and technological feasibility of such devices are major issues could prevent their use in the foreseeable future.

- Active collision-avoidance measures. It is possible for some spacecraft to maneuver so as to avoid collisions with large debris. Collision avoidance in GEO has been practiced by DoD for several years. If near-misses with large debris objects repeatedly occur, the satellite is maneuvered to a safer orbit. This orbit adjustment could be necessary if debris density near the orbit originally selected is greater than anticipated.

- Autonomous on-board detection and avoidance. Active collision avoidance is ultimately limited by the tracking capability and predictive accuracy of the current Space Surveillance Network. Tracking accuracy is not sufficient to justify the expense of propulsion and fuel for rapid maneuvering of spacecraft to avoid oncoming debris. Autonomous on-board detection and avoidance capability is a potential long-term solution but is not likely to be technologically feasible soon.

- Avoidance of collisions by delay of launch. Collision avoidance is generally practiced prior to launch of manned or man-capable spacecraft through the Collision Avoidance on Launch program. Some launches have been momentarily delayed to avoid flying close to orbiting objects (Interagency Group, 1989).

Spacecraft protection consists of shielding. Orbiting NMD assets would be shielded to protect against debris, and orbits would be selected and adjusted to minimize collision risks consistent with mission requirements. Shielding of spacecraft would protect against small debris. A variety of materials and designs have been and are being tested and developed to increase shield effectiveness. The problem is to design shields which protect against the greatest range of threats. Typically shields are most effective against debris of a given size and relative velocity. In addition, upon impact with a shielded spacecraft, debris can be fragmented into large numbers of smaller debris. This could exacerbate the very problem against which shields are intended to protect (Interagency Group, 1989).

A number of the measures mentioned above are already standard procedure for federal agencies and could be expected to be applied to NMD activities.

Research into degradation-resistant materials is ongoing. Separation of satellites from upper stages generates less debris and takes place at lower altitudes than used to be the case. Anti-satellite weapons tests are conducted in very low orbit, where reentry takes place within a few months.

H.2.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

H.2.2.1 Development and Testing

The types of potential effects from orbital debris in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section H.2.1.1 for the Preferred Action. However, the number of test launches could be somewhat greater with potentially additional orbital debris.

H.2.2.2 Later Life-Cycle Phases

As a point of reference and not representative of the current Ballistic Missile Defense Program, is the 1990 Office of Technology Assessment (USOTA, 1990) a study examining the collision probabilities for the space-based elements of the Strategic Defense System (SDS) as proposed at that time. The study was based on the most current National Aeronautics and Space Administration (NASA) model for predicting debris environments. For space-based interceptors (SBIs), estimates of the number of collisions over a 10-year period with debris 0.3 centimeter (0.12 inch) or larger ranged from less than 1 to 26, depending on the assumptions concerning debris proliferation over time. It was assumed that SBIs were to be deployed in two constellations of different orbital inclinations at about 440 kilometers (248 miles) altitude. The estimates of the number of collisions over 10 years with debris over 1 centimeter (0.39 inch) in diameter ranged from about 0.06 to 1.3. The surveillance assets proposed for SDS at that time consisted of Space Surveillance and Tracking System (SSTS) satellites deployed in high-inclination orbits of approximately 2,000 kilometers (1,242 miles) and Boost Surveillance and Tracking System (BSTS) satellites deployed above geosynchronous altitude. Estimates of debris collisions with SSTS assets ranged from approximately 0.8 to 4.1 for debris larger than 0.3 centimeter (0.12 inch) in diameter and from about 0.1 to 0.5 for debris larger than 1 centimeter (0.39 inch) in diameter. The debris density for the BSTS asset environment is sufficiently low that collisions were assumed to be extremely unlikely.

The probability of SDS assets colliding with other operational satellites is obviously much smaller than the estimates cited above, although the study found a risk of collision if a NASA space station (such as the proposed

Space Station Freedom) were deployed at the same orbital altitude. Important conclusions of the study included the following:

- Shielding must be used to protect SDS assets from debris.
- Planning can ensure that debris damage does not compromise the effectiveness of the system as a whole.
- Deployment and support of SDS would increase the potential sources of space hardware fragmentation.
- At altitudes planned for SBIs, atmospheric drag would deorbit most fragmentation debris within a few months.

At the end of their useful lives, space-based elements would either be deorbited or boosted into parking orbits where they would be expected to remain indefinitely. If the satellites were boosted into permanent orbits, the impact to orbital debris would be anticipated to be minimal. Orbital heights would be chosen so as not to interfere with commercial or military uses of space. That is, the satellites would be placed at altitudes not used by commercial or military interests. Debris densities in these areas would be low, so collisions would be unlikely to occur and of lesser importance if they did.

H.2.2.3 Methods to Reduce the Generation of Orbital Debris

The methods described in Section H.2.1.2 to reduce the generation of orbital debris could also be applied to this Alternative.

H.2.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

H.2.3.1 Development and Testing

There would be substantially less, if any, orbital debris generated under this Alternative.

H.2.3.2 Later Life-Cycle Impacts

There would be substantially less, if any, orbital debris generated under this Alternative.

H.2.3.3 Methods to Reduce the Generation of Orbital Debris

The methods discussed in Section H.2.1.2 to reduce the generation of orbital debris could apply to this Alternative, if any orbital debris is generated.

H.2.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

H.2.4.1 Development and Testing

The types of potential impacts related to orbital debris from development and testing under this Alternative would be as described for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative in Section H.2.2.1 and would utilize the same materials.

H.2.4.2 Later Life-Cycle Phases

Potential orbital debris impacts resulting from basing and decommissioning activities under this Alternative would not generally differ from those occurring under the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors Alternative. However, the likelihood of these impacts could be somewhat less, since no SBIs would be placed into orbit under this Alternative.

H.2.4.3 Methods to Reduce the Generation of Orbital Debris

The methods discussed in Section H.2.1.2 to reduce the generation of orbital debris could apply to this Alternative.

Appendix H References

Chobotov, V., 1990. *A Review of Orbital Debris Modeling at the Aerospace Corporation*, American Institute of Aeronautics and Astronautics, Washington, D.C., April.

Interagency Group, 1989. *Report on Orbital Debris*, National Security Council, Washington, D.C., February.

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Appendix I

APPENDIX I

HAZARDOUS MATERIALS AND WASTES

APPENDIX I

HAZARDOUS MATERIALS AND WASTES

Appendix I identifies typical hazardous materials and hazardous wastes both used and generated by activities that could occur under the Ballistic Missile Defense Program, including elements, compounds, mixtures, and materials of complex composition. Table I-1 identifies these materials and wastes by type, constituent, and use.

Table I-1. Typical Hazardous Materials and Wastes for BMD Activities (Sheet 1 of 2)

Type	Constituent	Use
Solvents	1,1,1-trichloroethane Freon 113 Isopropyl Alcohol Trichloroethylene Others	Cleaning and electronics applications
Solid Rocket Propellants	Powdered Aluminum Powdered Boron Nitrocellulose Nitroglycerin Cyclotetramethylene Tetranitramine (HMX) Ammonium Perchlorate Beryllium Hydride Chlorine Pentafluoride	Primary propellants in missiles
Liquid Rocket Propellants	Monomethyl Hydrazine (MMH) Unsymmetrical Dimethyl Hydrazine Nitric Acid Ammonium Perchlorate Beryllium Hydride Chlorine Pentafluoride Deuterium Fluoride Inhibited Red Fuming Nitric Acid Liquid Oxygen Liquid Hydrogen	Missile directional thrusters
Oxidizers	Ammonium Perchlorate Ammonium Nitrate Nitrogen Tetroxide	Combusts fuel in missiles

Table I-1. Typical Hazardous Materials and Wastes for BMD Activities (Sheet 2 of 2)

Type	Constituent	Use
Heavy Metals and Heavy Metal Compounds	Mercury Cadmium Tellurium Beryllium Fused Beryllium Triphenyl Bismuth Dimethyl Isocyanate Gallium Arsenide Silicon Arsenide Cesium Iodide Polyphenylene Sulfide Arsenic-Doped Silicon Indium Animonide Indium Arsenic Antimony Cadmium Tellurium Selenium Cadmium Tellurium	Optical, sensor, electronic, and structural components and as minor ingredients in solid rocket propellants
Metal Batteries	Lithium Thionyl Chloride Lithium/Iron Disulfide Zinc/Silver Oxide Pyrotechnic Material Lithium Zinc Lead Silver Nickel Solvents Chlorine- and Sulfur-Based Acids	Electric power supply to onboard missile guidance systems
Etchants	Sulphuric Acid Phosphoric Acid Nitric Acid Hydrogen Fluoride Ammonium Fluoride Ethanol	Preparation of metal part surfaces
Pesticides	Various	Facility maintenance
Other	Asbestos	Rocket motors

Appendix J

APPENDIX J

HEALTH AND SAFETY HAZARDS

APPENDIX J

HEALTH AND SAFETY HAZARDS

Appendix J identifies the various toxic and hazardous substances and potentially hazardous physical agents used in activities similar to those that would occur under the Ballistic Missile Defense Program, and discusses their potential hazards to human health and safety. Table J-1 identifies these toxic and hazardous substances by element, compound, mixture, and material of complex composition. Table J-2 identifies potentially hazardous physical agents including non-ionizing electromagnetic radiation, energy beams, noise, explosions, deorbiting debris, extreme cold, and static electric and magnetic fields.

Table J-1. Toxic and Hazardous Substances in the BMD Program (Sheet 1 of 3)

Substance	Use	Adverse Effects on Human Health
Beryllium	Sensor mirrors, optical benches, lightweight rigid structures, and beryllium-based rocket fuels.	Beryllium dust can cause berylliosis, a chronic lung disease. Beryllium dust and powder are flammable. Beryllium-based rocket fuels represent potential health risks associated with manufacturing, ground transportation/handling, ground testing, and atmospheric flight testing.
Boron Silicate	Optical fibers.	Boron and boron compounds can affect the central nervous system, depress circulation, and cause gastrointestinal distress.
Cadmium	A component of $(HgCdTe)_2$ which is used in infrared detectors associated with phenomenology and sensor technology.	A carcinogen which is also toxic, causing bone, lung, and cardiopulmonary disorders.
Carbon Composites	Construction materials.	Possible effects from inhalation of airborne fibers. Since composites are relatively new, there are insufficient medical data to reveal chronic or latent diseases.
Cesium Iodide	Development of sensor/seeker windows for endo/exoatmosphere interceptors.	Moderately toxic by ingestion. When heated, it emits toxic fumes. Prolonged absorption may cause skin rashes, runny nose, headache, and irritation to mucous membranes.
Deuterium Fluoride and Hydrogen Fluoride	Generated in chemical laser research; hydrogen fluoride is used in the production of semiconductor chips.	Moderately toxic by inhalation. When heated to decomposition, both emit toxic fluoride fumes.

Table J-1. Toxic and Hazardous Substances in the BMD Program (Sheet 2 of 3)

Substance	Use	Adverse Effects on Human Health
Gallium	Production of optoelectronic devices.	Toxic when inhaled or ingested.
Gallium Arsenide	Integrated circuits and solar cells.	Can react with steam, acids, and acid fumes to produce deadly arsine gas. Arsenic is poisonous, and short-term exposure can cause gastrointestinal, mental, and physical disorders. It is also a probable carcinogen.
Germanium	High-frequency and high-power applications as a substrate for light emitting diodes, and is the material of choice for the ground-based interceptor's sensor optical lens.	No health risks associated with pure-grade germanium; it is mined and processed in the presence of other toxic materials.
Lithium hydride	Candidates for radiation shielding materials for small, space-based nuclear reactors.	May produce local irritations and destroy red blood cells. They are particularly dangerous because of their volatility and ease of entry into the body. Volatile hydrides are flammable and may form explosive mixtures with air. Hydrides could form dust clouds that can explode upon contact with flames, sparks, heat or oxidizers.
Hydrogen Chloride	By-product of rocket exhaust.	Hydrogen chloride reacts with water vapor to form hydrochloric acid, which is toxic and may cause severe burns.
Indium	Semiconductors formed in infrared detectors and missile guidance systems, and as a dopant for various semiconductor connections.	Has been shown to cause cell and chromosome damage in laboratory animals. Inhalation of Indium compounds may cause damage to the respiratory system.

Table J-1. Toxic and Hazardous Substances in the BMD Program (Sheet 3 of 3)

Substance	Use	Adverse Effects on Human Health
Lead	Storage batteries, solder, vibration damping, radiation shielding, paint pigments, composite friction materials, a gasoline additive (degreasing use).	Lead is a cumulative poison. Excessive levels of lead in air, food, or water can cause a buildup in the body, leading to lead poisoning. Lead poisoning results from interference with enzymatic processes, which causes impairment of blood formation and kidney function, and injury to the nervous system.
Mercury	Semiconductor dopant and as a component of $(HgCdTe)_2$ which is used in infrared detectors associated with phenomenology and sensor technology.	Can be absorbed through the skin and is harmful to eyes and mucous membranes. Prolonged exposure can result in tremors, allergic reactions, kidney trouble, and mental disturbance.
Tellurium	A component of $(HgCdTe)_2$ which is used in the fabrication of infrared sensors.	Tellurium ingestion causes central nervous system disorders and is harmful to fetal development.
Other materials of concern: composites, advanced composites, and their materials of production; superconducting materials and their production processes; and semiconductors and other materials.	Various uses for each.	There is insufficient knowledge of their specific characteristics and effects on human health or the environment.

Source: Adapted from BMDO, 1993.

Table J-2. Potentially Hazardous Physical Agents in the BMD Program (Sheet 1 of 3)

Physical Hazard	Use/Activity	Comment
Cryogenic materials including liquid argon, helium, hydrogen, nitrogen, oxygen, and Freon	Used in Ballistic Missile Defense (BMD) processes as supercoolants.	These exclude oxygen from the lungs. Skin contact can cause severe cold burns. Heat leakage into a cryogenic liquid container may cause an unvented container to rupture and fragment.
Explosives	Used in rocket motors and explosives, stage separators, and explosive bolt applications. Bursts, shatters, penetrates, lifts, creates airblast, and creates shock waves on command.	The explosive decompression with attendant evolution of heat and gas gives rise to a host of safety precautions required whenever dealing with explosives. Must prevent uncontrolled explosions.
Non-ionizing electromagnetic radiation (EMR) (discussed in detail in Section 3.3)	Typical sources of (EMR) include directed energy weapons, radios, radars, and microwave sources used to communicate, acquire and track targets, and control operations; devices used to test the survivability or "hardness" of components and systems, including lasers operating in non-ionizing regions of the spectrum and electromagnetic pulse simulators, and EMR-emitting devices used in fabricating components and systems, such as laser welding and cutting tools.	Higher frequency (EMR) may cause cellular heating, leading to skin and eye damage. Low frequency radiation has been correlated to higher cancer incidences in some studies. EMR can also potentially cause fuel ignition during refueling operations and can cause the inadvertent detonation of Electroexplosive Devices.

Table J-2. Potentially Hazardous Physical Agents in the BMD Program (Sheet 2 of 3)

Physical Hazard	Use/Activity	Comment
Lasers	Test BMD components for their ability to survive attack by enemy laser weapons, as well as for detecting, ranging, tracking, and targeting objects.	Almost all lasers are optical hazards, but some can be chemical hazards as well. High-power lasers can damage human tissue. Safety procedures for any laser operation customarily vary according to three aspects: the laser hazard classification, the environment where the laser is used, and the personnel operating or in the vicinity of the laser's beam.
High-voltage electricity	In integrated electrical components, such as radars, lasers, and missile interceptors.	May cause electrical shocks and burns. Stray voltages in circuits involved with arming and firing of warheads, propellants, and explosive charges may cause accidental ignitions.
Hazardous/toxic material spills	During storage, transport and handling.	These activities present opportunities for error which could result in spills of toxic and/or hazardous materials, with attendant possibility of reactions, including fire, toxic fumes, and/or explosions.

Table J-2. Potentially Hazardous Physical Agents in the BMD Program (Sheet 3 of 3)

Physical Hazard	Use/Activity	Comment
Launch effects	During rocket launch.	Launch hazards might include propellant and/or booster explosion, toxic vapor clouds, fires, and explosion debris. Explosive Safety Quantity Distance arcs (199 CFR 6055.9), as well as launch area safety parameters, will be factored into each launch activity. Errant missile destruction by a Range Safety Officer can be performed in flight. Falling debris from a missile's premature explosion or directed early termination could consist of explodable or burning pieces of solid propellant and metal pieces coated with toxic or hazardous material. Downrange impact areas must be kept free of intruders.

Source: Adapted from BMDO, 1993.

Appendix J References

BMDO, see Ballistic Missile Defense Organization.

Ballistic Missile Defense Organization, 1993. Final Theater Missile Defense Programmatic Life-Cycle Environmental Impact Statement, Washington, D.C., September.

Appendix K

APPENDIX K

SOCIOECONOMIC IMPACT ANALYSIS

METHODS AND APPROACH

APPENDIX K

SOCIOECONOMIC IMPACT ANALYSIS METHODS AND APPROACH

Appendix K contains the methodology and approach used to assess socioeconomic effects (Sections K.1 and K.2), the definition of terms used to describe socioeconomic impacts (Section K.3) and a detailed description of the socioeconomic impacts associated with Ballistic Missile Defense (BMD) activities (Section K.4). Section 4.13 contains a summary of socioeconomic impacts, and mitigation measures as described in this Appendix.

K.1 METHODOLOGY

The methodology for assessing socioeconomic impacts is based on the type and intensity of proposed activities relative to potential changes to the capacity of community services. The primary objective of this methodology is to determine the levels of analysis required to further assess community impacts associated with proposed activities. Some activities may only require analysis at the programmatic level to assess potential impacts. Potential impacts from other activities may be unknown at the programmatic level and could require further analysis at a regional or local level.

As described in the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) (40 CFR 1508.14), potential socioeconomic impacts are addressed only to the extent that they are interrelated with natural or physical effects (Fogleman, 1990). The primary determinants of community-level impacts are changes in the economic base and demographic composition resulting from the implementation of an alternative.

Assuming that total employment will rise from a proposed activity, and that some of this increase is associated with in-migration, it is likely that the demand for local services will rise. The new workers and their families will demand commodities, public services, such as schools, health and so forth, and thus create the necessary conditions for an expansion of the economic base of the region. Whether this occurs will depend in part on the degree of excess capacity that may already exist in some firms and public services (Hewings, 1985).

Potential impacts to public services occur when demand exceeds supply of these services, referenced as deficient capacity. In addition, impacts could occur to the natural or physical environment as a direct result of proposed activities or as an indirect result of changes in the structure of the economic system. Likewise, socioeconomic conditions are affected by changes in the natural or physical environment.

K.2 MACRO SOCIOECONOMIC SYSTEM APPROACH

The socioeconomic methodology employs a macro approach of qualitatively simulating the flow of resources in the regional economy from a proposed activity to eventual community impacts (Figure K-1). Changes in the regional economy are qualitatively assessed by tracing the flow of production among various sectors of the economy to final demand or export.

The macro regional economic approach focuses on the relationship between BMD program requirements including labor, capital, and land requirements, and a community's capacity to accommodate these requirements (Figure K-2). Labor demand refers to the human resources necessary to produce a certain good or service. In addition, these activities will demand capital and land requirements. Capital demand refers to the physical resources (e.g., buildings and equipment), or "hard" costs associated with the production process. Land demand includes raw materials and other natural resources used as inputs for the production of a commodity (good or service).

Growth in areas with under- or over-utilized community service capacities can result in minimal to substantial local operational or capital expenditures. The change in population itself, relative to costs per capita, would not be the best indicator of future costs. This type of impact would demand an analysis sensitive to existing excess or deficient service capacity (Burchell, 1978). For example, large communities experiencing slow growth or decline could have municipal and educational infrastructures with excess capacity; therefore, future growth as a result of new development could require no additional community services. Likewise, small or rural communities experiencing moderate to rapid growth could have minimal operating services and capital facilities; therefore, future growth could require substantial local operational or capital expenditures. In excess capacity cases, minimal costs would be assigned, while in deficient capacity cases, substantial costs would be assigned (Burchell, 1978).

This approach analyzes the direct and indirect socioeconomic impacts associated with labor, capital, and land requirements for each BMD alternative. Any environmentally related or direct infrastructure impacts associated with the use of capital will not be reflected in this approach; however, these impacts are discussed in terms of total community impacts in this Programmatic Environmental Impact Statement (PEIS).

At a programmatic level, exact geographic locations of proposed activities are often unknown, presumably preventing analysis of potential socioeconomic impacts; however, labor, capital, and land requirements are often in sufficient detail to determine the levels of analysis required to assess potential impacts. Requirements for employees or materials (yes/no

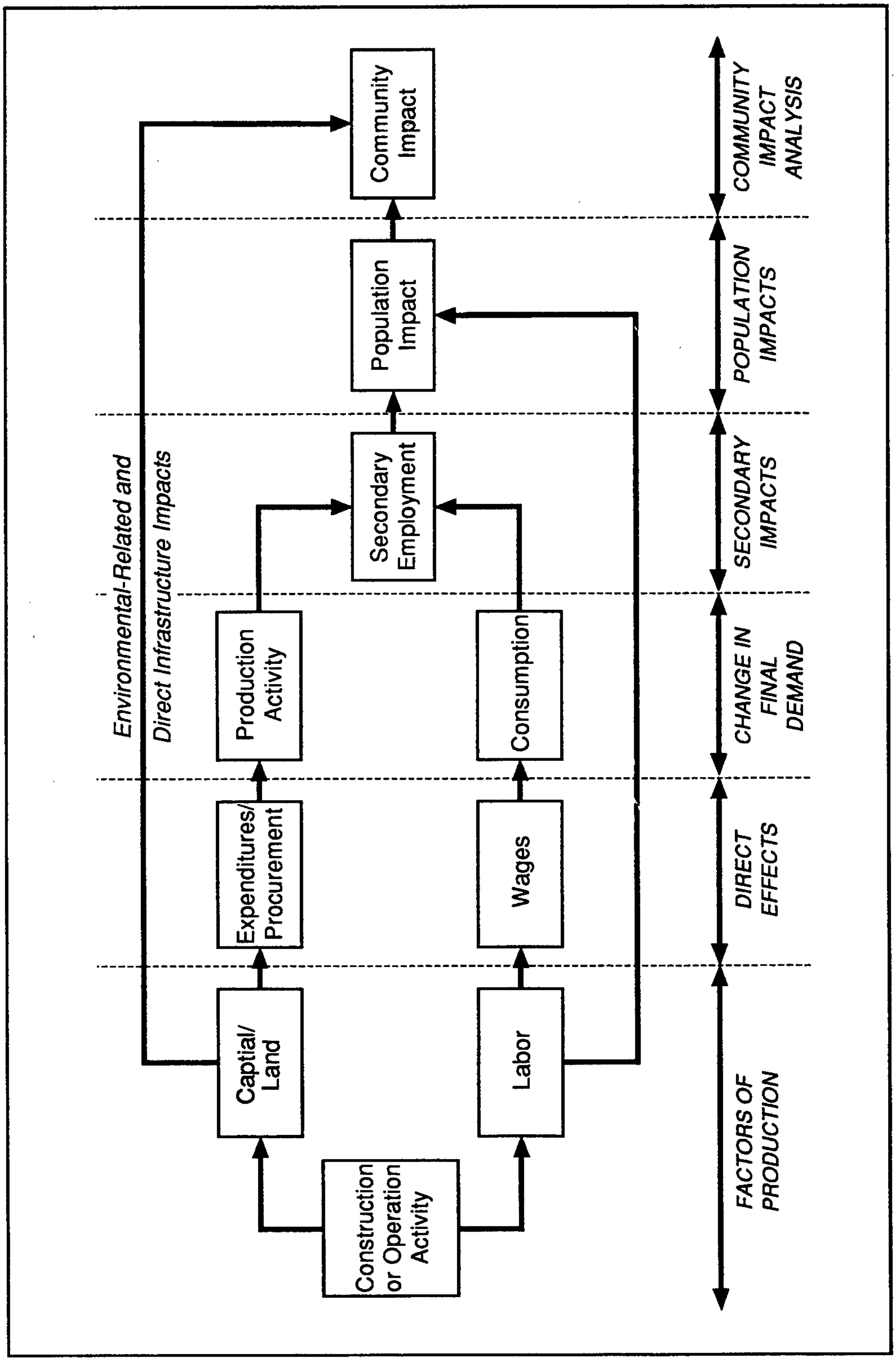

Figure K-1. Macro Socioeconomic System Approach

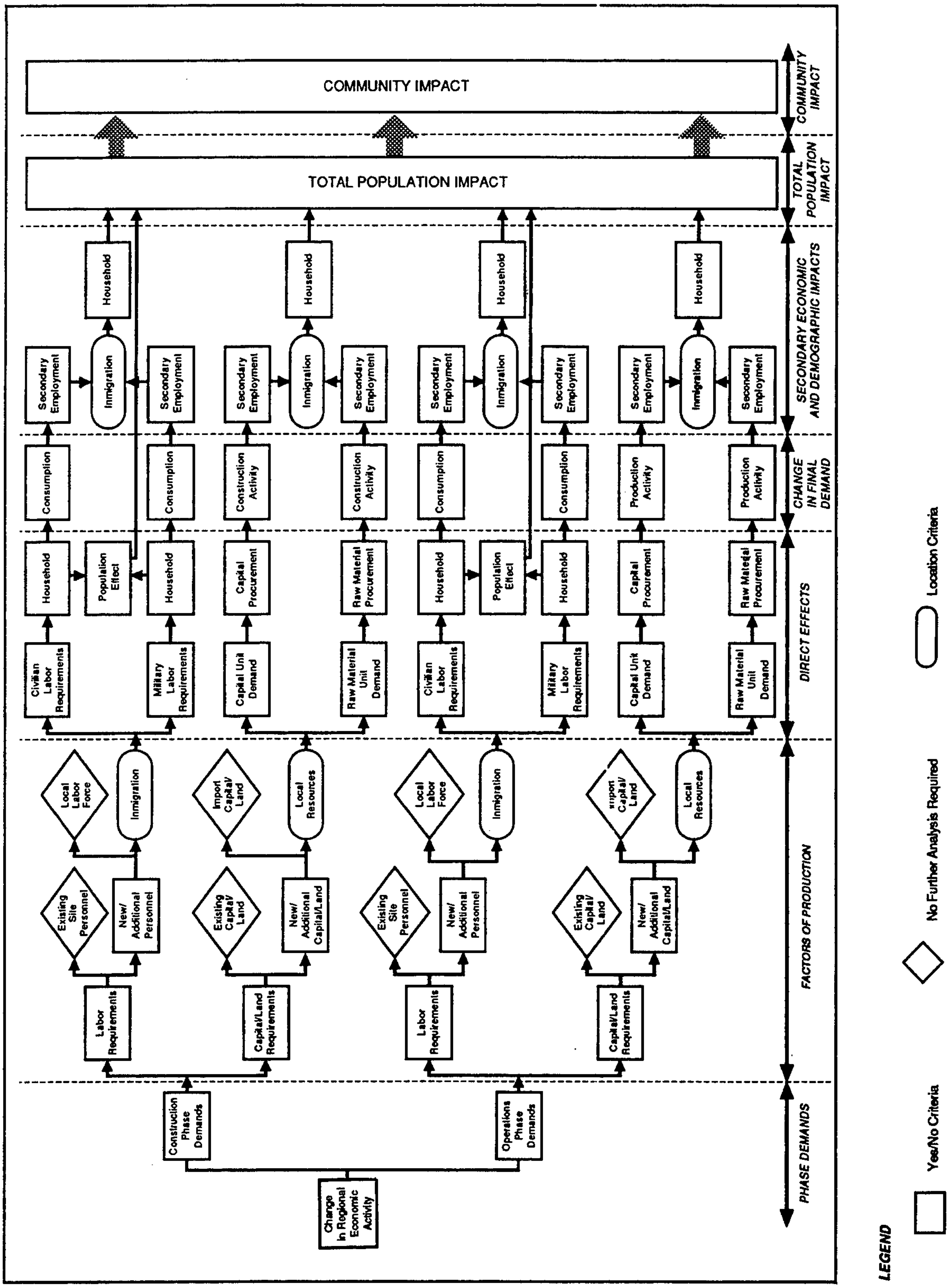

Figure K-2. Program Impact Assessment Model

situation) and sources of requirements (local versus in-migration/import) provide direction in determining the levels of analysis, and possibly the levels of impact.

K.2.1 PROGRAM IMPACT ASSESSMENT MODEL

The program impact assessment model schematic identifies potential changes in the economic system, representing micro-level interaction. These changes could have further impacts on the structure of both production and consumption in the regional economy. The model consists of seven phases:

- Phase Demands
- Factors of Production
- Direct Effects
- Change in Final Demand
- Secondary Economic and Demographic Impacts
- Population Impacts
- Community Impacts

The initial two phases, phase demands and factors of production, would determine the level of analysis required to assess impacts.

K.2.1.1 Phase Demands

In the initial phase, the proposed activity would have two types of phase demands:

- Construction Phase Demands
- Operation Phase Demands

Construction phase demands include economic activity resulting from facility and plant construction and/or modification at a given site. Operation phase demands include the actual activity that would occur on a site.

K.2.1.2 Factors of Production

The second phase of the decision-based model approach identifies the resources that would be required during construction and operation phase demands:

- Labor Requirements
- Capital/Land Requirements

Labor requirements include the human resources necessary for various activities. These activities would also include demand capital and land

investment. Capital requirements include plant and equipment, while land consists of raw materials and natural resources used as inputs of production. The proposed phase demand (i.e., construction, operation) would be assessed to determine factor of production requirements for a proposed activity. Labor could be supplied by existing site personnel, requiring no new employment, or by new/additional personnel, requiring local labor or in-migration of labor. Capital and land would be supplied by either existing resources, requiring no new capital or land, or additional capital or land, requiring the use of imported or local resources.

Level of Analysis

The required factors of production determine the levels of analysis required for a particular activity (Table K-1). If the proposed activity utilizes existing site personnel, capital, or land, no further analysis would be required because no additional employment, capital, or land would be required. No direct effects from labor requirements would be anticipated because there would be no changes in population or household consumption levels. In addition, no direct effects from capital or land requirements would be anticipated because there would be no changes in capital or raw material unit demand at the local level.

If the proposed activity requires additional labor, capital, or land, the probable community supply characteristics for these resources would be required to determine sources and measure potential impacts. The impact caused by a proposed activity would depend on the extent to which a local economy supplies the input requirements for the activity.

If the determination is made that a probable community size, based on a typical labor force, could supply local labor, verification at a regional or local level would be required to confirm available labor resources. No other labor analysis would be required because no direct effects would be anticipated (i.e., no in-migration).

If the unemployed labor force can satisfy program labor requirements, it is assumed that changes in consumption expenditures are negligible because unemployment benefits would be approximately 90 percent of former labor incomes. The disparity in foregone income versus unemployment benefits is offset by employing unemployed labor (Hewings, 1985). No changes in population or household consumption levels would be anticipated; therefore, no community impacts would be anticipated.

If the community could supply capital or land resources, further analysis at the regional or local level would be required to determine potential direct effects for procurement of capital/land and other tangible resource requirements. Direct effects could lead to changes in final demand. It is

Table K-1. Decision Criteria Matrix; Levels of Analyses

Phase	Factors of Production	Labor or Capital/Land Requirements	Source of Labor or Capital/Land	Level of Impact	Level of Analysis
Operations	Labor	No New/Additional Employment	Existing Site Personnel	Not Significant	No Further Analysis Required
		New/Additional Employment	Local Labor Force	Not Significant (Pending)	Verification Required at Regional or Local Level
		New/Additional Employment	Inmigration of Labor	Undetermined	Further Analysis Required
	Capital/ Land	No New/Additional Facility/Resource Requirements	Existing Capital/Land	Not Significant	No Further Analysis Required
		New/Additional Facility/Resource Requirements	Local Capital/Land	Undetermined	Further Analysis Required
		New/Additional Facility/Resource Requirements	Import Capital/Land	Not Significant (Overall)	Further Environmental-Related and Direct Infrastructure Impacts Analysis Required (Use of Capital)
Construction	Labor	No New/Additional Employment	Existing Site Personnel	Not Significant	No Further Analysis Required
		New/Additional Employment	Local Labor Force	Not Significant (Pending)	Verification Required at Regional or Local Level
		New/Additional Employment	Inmigration of Labor	Undetermined	Further Analysis Required
	Capital/ Land	No New/Additional Facility/Resource Requirements	Existing Capital/Land	Not Significant	No Further Analysis Required
		New/Additional Facility/Resource Requirements	Local Capital/Land	Undetermined	Further Analysis Required
		New/Additional Facility/Resource Requirements	Import Capital/Land	Not Significant (Overall)	Further Environmental-Related and Direct Infrastructure Impacts Analysis Required (Use of Capital)

these changes in final demand that could have a multiplier effect, creating secondary impacts such as additional output, income, and employment. These impacts could lead to changes in total population and further increase demand for community services.

If in-migration of labor is required, then further analysis at the regional or local level could be required to determine direct effects as a result of operation and/or construction activity. Changes in final demand facilitated by labor are driven by income, which in turn determines personal consumption expenditures for consumer durable goods and services in the local economy. Procurement for goods and services in the local economy to support operation and construction activities also causes changes in final demand. These changes lead to additional population growth and an increase in demand for community services. The degree of impact would be dependent on the geographic location, the structure and diversification of the economic base, and the demographic composition of the community. If importing capital, raw materials, or other resources is required, no further analysis would be warranted because most of the impacts would be anticipated to occur outside the region.

K.2.1.3 Direct Effects

The third phase identifies the direct effects associated with the factors of production. Further analysis at the regional or local level would be required to quantify direct effects. Direct effects would include:

- In-migration of Labor
- Local Capital/Land Resources

The in-migration of labor and use of local resources for capital or land could result in direct effects to the regional economy. The effects from the in-migration of labor could be in the form of civilian and/or military labor requirements with associated household population effects and income effects (in terms of wages and salaries paid to labor). The effects from use of local resources for additional capital/land could be in the form of capital and/or raw material unit demands, each leading to procurement of capital and materials and supplies employed in the production activity.

K.2.1.4 Change in Final Demand

Changes in final demand for labor, capital, and land requirements occur in the fourth phase. Wages and household income drive consumption of consumer durable goods, and production and construction activities from capital or raw material procurements result in industry linkage in and outside the economic system. Changes in either consumption or production in the

regional economy could lead to changes in the other and, in turn, to further changes in consumption.

Various categories of site employees would likely exhibit different local expenditure patterns. The level of consumption for civilian households would be different, and most likely higher, than for military households. For example, military personnel receive some goods and services as payment in kind so that their expenditures on these particular items, relative to their total expenditures, would be less than their civilian counterparts. In addition, purchasing habits within the military population itself would vary. For instance, permanent military personnel who live on base would exhibit a different spending pattern than that exhibited by those who reside off base, because the base provides and maintains living quarters (Cartwright, 1980).

Procurement of capital or raw materials would likely lead to changes in final demand depending on construction versus operation activities.

K.2.1.5 Secondary Economic and Demographic Impacts

The changes in final demand for consumption or production and construction activities, could have multiplier effects creating secondary impacts such as additional output, employment, and earnings. Secondary employment effects, which could increase in-migration, would be anticipated from household consumption and construction and production activities. The secondary employment effects also would have an associated household population.

K.2.1.6 Population Impacts

Population impacts could be determined from the primary direct labor requirements and the resulting secondary employment impacts from the use of local resources for capital/land requirements and household consumption levels. Distribution of the in-migrant population could be affected by a large number of factors, including geographical setting, service preferences, and character of potential settlement areas.

K.2.1.7 Community Impacts

The final phase of the model is the community impact analysis. Community impacts would affect resources such as public services, public finance, housing, education, transportation, and utilities. Resulting population impact and direct infrastructure requirements would drive this phase of analysis.

To determine potential community impacts, the existing service capacities of a particular community would be assessed. A large community with declining growth could have excess service capacity, while a large

community with increasing growth could be at capacity or have deficient capacity. Likewise, a rural or small community with no or declining growth could be at capacity or excess capacity, while this same type of community with increasing growth could have deficient capacity. "Excess capacity" means that the service system is underutilized and exhibits room for service expansion without significant additional operational or capital expenditures. "At capacity" means that the service system is operating at its most efficient level; most service categories exhibit neither over- nor underutilization. "Deficient capacity" means that the service system is overutilized; the slightest form of additional service demand will require significant operational or capital expenditures (Burchell, 1978).

It should be noted that basic sector changes have a much smaller impact on large, diversified regional economies than on small, specialized economies. The basic sector consists of firms and parts of firms whose economic activity is dependent on factors external to the local economy (Klosterman, 1990).

K.3 DEFINITION OF PROGRAMMATIC TERMS

This section defines the levels of analysis, levels of impact, and types of activities for programmatic-level analysis.

K.3.1 LEVELS OF ANALYSIS

The levels of analysis for socioeconomic effects are dependent on labor, capital, and land resources required to conduct proposed activities. To determine the nature and extent of the socioeconomic impacts associated with proposed activities, two possible categories with varying levels of analysis exist for assessing activities: programmatic/non-site-specific and regional/local. To discern potential impacts at the programmatic/non-site-specific level, socioeconomic issues and concerns are dependent upon labor, capital, and land requirements, irrespective of geographical location. The following criteria are used to determine the level of analysis required:

- Program requirements would not be anticipated to cause socioeconomic impacts—no further analysis would be required; or

- Further analysis could be required.

At the regional or local level, assessments of potential socioeconomic impacts are based on more specific information about the program's requirements, and on the socioeconomic characteristics of a region or host community.

K.3.1.1 Regional/Local Issues and Concerns

If program activities were to lead to the in-migration of new workers into a host community and/or extra-regional transactions involving capital, raw material, or other resources, various levels of regional/local analysis could be required to determine socioeconomic impacts. The following variables would be important at this level:

- Type of Labor Required. How much of the additional labor would be supplied by military personnel? How much by civilian? How many skilled workers would be required? How many unskilled? What would be the income generated by these different employee types? These factors have to be determined to estimate how much total household income would be generated by the proposed activities.

- Existing Employment and Labor Force Composition, and Participation. Would the additional labor be supplied locally or would in-migration of labor be required? The use of locally available labor would require site-specific verification of relevant labor force characteristics (e.g., unemployment rate, labor force participation). Large, economically diverse communities are generally able to provide labor with minimal economic dislocation, but smaller communities are sometimes unable to accommodate a project's labor requirements. Worker in-migration generally occurs less in areas with high unemployment or low labor force participation.

- Type of Capital/Land Required. How much of the additional capital, raw materials, or natural resources would be supplied by the military or by the federal government? How much would be supplied by civilian or contractor sources? Would local land have to be acquired?

- Existing Capital/Land. Would these additional physical resources come from local suppliers or would capital, raw materials, or natural resources be imported from outside the region?

- Intensity and Duration of an Activity. Would high employment levels be sustained for extended periods of time? Employment generated by a development project typically fluctuates as it moves through its life cycle. An initial "start-up" phase, marked by low but gradually increasing employment, is usually followed by a peak phase in which employment is highest and activity most intense. During the final phase, employment drops off to the number of workers who are left to operate and maintain the project until its completion (Finsterbusch, 1983).

K.3.1.2 Socioeconomic Variables

Project-related growth could affect, and be limited by, housing, education, public services, finance, and infrastructure. These socioeconomic variables could be quantified in further environmental analysis at a regional or local level. The primary criterion for assessing these socioeconomic variables at this level would be a region's capacity to absorb changes to employment and population levels. The choice of variables would include but not be limited to the following:

- Housing availability and growth potential
- Infrastructure demand and capacity
- Transportation network levels of service and capacity
- Public service levels and capacity
- Educational system profile and capacity
- Public finance profile

The following definitions describe levels of analysis used in this PEIS:

No Further Analysis Required

Further analysis would not be required for a proposed activity. Potential impacts could be determined by production or resource requirements and sources at the programmatic/non-site-specific level.

Verification at the Regional/Local Level Required

Verification would be required at the regional or local level to confirm potential impacts established by production or resource requirements; otherwise, no additional analysis would be required.

Further Regional/Local Level Analysis Required

Analysis would be required at the regional or local level where specific information on geographic location and demographic composition is required to determine potential impacts.

Environmental-Related and Direct Infrastructure Impacts Analysis Required

Further analysis would be required at the regional or local level to discern potential environmentally related and direct infrastructure (e.g., transportation, utilities upgrades) impacts from use of capital. Potential impacts from production resource requirements would be determined at the programmatic/non-site-specific level without further analysis.

K.3.2 LEVELS OF IMPACT

Potential impacts are based on a determination of the levels of analysis previously described for the factors of production. No further analysis would be required for a proposed activity when no adverse impacts or negligible impacts would be anticipated at the programmatic level. Further analysis could be required at the regional or local level when potentially adverse impacts could be anticipated or are unknown at the programmatic level. The levels of impact include:

K.3.2.1 No Impact

No impact would be anticipated because there would be no new resource requirements. Further analysis would not be required.

K.3.2.2 No Adverse Impact

No negative impacts would be anticipated because changes in production or resource requirements, if any, would be minimal (i.e., employment or population would not change); therefore, the level of community services for housing, utilities, transportation, public service/finance would be anticipated to remain unchanged and would not result in adverse environmental impacts. Further analysis would not be required.

K.3.2.3 No Adverse Impact (Pending)

No negative impacts would be anticipated pending verification at the regional or local level of proposed activity in terms of labor resources.

K.3.2.4 No Adverse Impact (Overall)

No negative impacts would be anticipated from production or resource requirements, in terms of employment and population effects; however, further analysis would be required to discern environmentally related and direct infrastructure impacts.

K.3.2.5 Undetermined

Impact could not be determined because production and resource requirements would be undefined at the programmatic level or labor resources would require in-migration and/or capital or land sources would require use of local resources; therefore, further analysis would be required at the regional or local level to discern potential socioeconomic impacts.

K.3.2.6 Beneficial Impact

Positive impacts could be anticipated from activity.

K.3.3 TYPES OF ACTIVITY

K.3.3.1 Normal Operations

Operations that typically occur at an existing facility or site. Existing employees and facilities would be utilized to meet activity requirements.

K.3.3.2 New Operations

Operations that are new to an existing facility or require construction of a new facility. Additional employees would be required to meet activity requirements.

K.3.3.3 Minor Modifications

Facilities may require modification for normal operations. These activities would be performed by existing employees or require minimal new employees and would not require additional capital/land.

K.3.3.4 New Construction

New facilities may be required at existing or new locations. These activities would require additional employees and capital/land.

K.4 SOCIOECONOMIC IMPACTS

Potential impacts to a community's socioeconomic system from NMD activities under the Preferred Action or any of the Alternatives could have either no adverse effect, and consequently, no adverse effect on the environment, or would be unknown at the programmatic level and may require further analysis at a regional or local level to determine socioeconomic and environmental effects.

The ability to measure the levels of impact and appropriate mitigation measures depends on labor, capital, and land required to support the NMD activity, (see Sections K.1 and K.2), and, in some cases, the exact region or location. Potential impacts are discussed in terms of construction and operation activities, relative to factor demand linkages in a regional economy. Construction activities include facility and plant construction and/or modification, while operation activities could include research, production, testing, or management. Correlation between program

requirements and potentially significant socioeconomic impacts are summarized below.

Regardless of geographic location, the use of existing resources for construction or operation activities potentially would have no adverse effect on socioeconomic systems. No additional resources would be required to support the NMD activity. Adverse and beneficial direct effects from labor requirements are anticipated to be minimal because no changes would occur in population, or in household consumption levels. In addition, no direct effects from capital and land requirements would be anticipated because no changes would occur in unit demand for these resources at the local level. That is, there would be sufficient capacity from existing assets and inventories to accommodate the marginal demand of implementing a particular BMD activity. Thus, further environmental analysis would not be required for use of these resources.

If the NMD activity requires additional labor, capital, or land, additional resources would be supplied either locally or from outside the region.

If local labor supply is used, no adverse impacts on the economic structure or the environment of a community would be anticipated; however, verification at the regional or local level would be required to confirm available labor resources in the community. If the unemployed labor force in a community can satisfy NMD activity labor requirements, it is assumed that changes in consumption expenditures would be negligible because unemployment benefits would be approximately 90 percent of former labor incomes. The disparity in foregone income versus unemployment benefits is offset by employing unemployed labor (Hewings, 1985). Further environmental analysis would not be required from the use of local labor because in-migration of labor would not occur. Changes in population or in household consumption levels would not be anticipated; therefore, no community impacts would be anticipated.

If local capital and land resources are used, adverse impacts could occur depending upon regional or local characteristics. At the programmatic level, the amount of local capital and land requirements and location are unknown. Further analysis at the regional or local level may be required to determine potential impacts, because direct effects could lead to changes in final demand and eventually to secondary employment impacts. In turn, these impacts could lead to changes in total population and an increase in demand for community services.

If in-migrant labor is used to support NMD activities, potential adverse impacts may occur depending upon regional or local characteristics. Further analysis may be required at the regional or local level to determine potential impacts on a community's economy and environment. Direct effects, such

as increases in site personnel and income, could lead to changes in population and in household consumption. Consumer spending from household consumption could result in changes in final demand and eventually secondary job creation. In-migration of secondary jobs not supplied by the existing labor force also could lead to changes in population. The in-migration of population from site personnel and secondary employment could result in increases in demand for community services.

If capital, raw materials, and other resources were imported from outside the region for construction activities, no adverse socioeconomic impacts would be anticipated at the regional or local level; however, environmentally related and direct infrastructure impacts from the use of these resources could occur, which could require further analysis at the regional or local level.

K.4.1 PREFERRED ACTION (CONTINUED TECHNOLOGY READINESS PROGRAM)

The Technology Readiness Program is discussed for each element of the life-cycle activity. NMD activities under the Preferred Action could have varying levels of impact; therefore, discussion of each activity and component is necessary to establish levels of analysis and impact.

Development and testing activities consist of Battle Management/Command, Control, and Communications (BM/C3); Ground-Based Interceptor (GBI); Ground-Based Sensor (GBS); Space-Based Elements.

K.4.1.1 Battle Management/Command, Control, and Communications

The BM/C3 element would be tested at an existing remote Government installation such as the U.S. Army Kwajalein Atoll (USAKA) installation in the South Pacific. These activities at existing locations would be new operations requiring minor modifications of existing facilities and new construction of some program elements (i.e., Ground Entry Points (GEPs)). Operations at existing facilities would require personnel and capital to support BM/C3 activities. Modification activities would require minimal labor, capital, or land requirements, if any. Construction activities, however, would require labor, capital, and land to support GEP construction.

Required Factors of Production

The primary issue for BM/C3 activities is the amount of labor and capital required to support both operation and construction activities relative to location; however, the exact levels of labor and capital/land requirements are unknown. No adverse impacts would be anticipated if existing site personnel, facilities, and equipment are used. If local labor is used, no

adverse impacts would be anticipated because in-migration of labor would not occur; however, verification at the regional or local level would be required to confirm available labor resources. No changes in population or in household consumption levels would be anticipated. Potential impacts are undetermined at this level if in-migration of labor is required; therefore, further analysis at the regional or local level could be required depending upon community size and labor requirements because potential secondary economic effects could occur from increases in employment and population.

No overall adverse economic impacts would be anticipated if capital, raw materials, and other resources are imported from outside the region; however, environmentally related and direct infrastructure impacts could occur locally and at the site, requiring further analysis (see above, Non-Local Sources). If local resources are required, potential secondary economic impacts, as well as environmentally related and direct infrastructure impacts, are undetermined at this level; therefore, further analysis could be required depending on community size and capital requirements.

Factor Demand and Location Impacts

Although BM/C3 activity would be classified as normal for most of these sites, operations and construction activities could require resources through in-migration and importation of labor, capital, and other raw materials. Although existing labor could be utilized, in-migration of labor probably would be required to support these activities because of specialized program requirements; therefore, further analysis may be required at the regional or local level to discern potential impacts. Further analysis may be required for assessing environmentally related and direct infrastructure impacts associated with importing capital resources.

Depending on the duration of an activity, capital requirements, and the number of in-migrants, potential impacts at remote government installations could include shortages of temporary housing and inadequacies in utility, infrastructure, and transportation systems. The increased population associated with increased employment would directly affect demand for housing and other support facilities and services, including recreation, education and public health. For example, the primary potential for socioeconomic impacts at USAKA would involve housing. A shortage of permanent housing currently exists at USAKA and would continue unless new housing were constructed. Since available land for new construction is limited, constructing new housing or facilities could result in the loss of land devoted to other uses, such as recreation and open space. Housing for construction workers, however, would be the responsibility of construction contractors, who normally transport trailers to USAKA as temporary living quarters. Because adequate space is available at USAKA for temporary

trailers, the expected increase in the number of construction workers would not adversely affect housing conditions (USASSDC, 1993).

Beneficial and Spinoff Effects

Beneficial effects could be anticipated from these activities; however, the levels of impact would be difficult to estimate at the programmatic level. For example, increases in income and revenues to local governments would be anticipated. If USAKA is used for BM/C3 activities, then income and revenues of the Republic of Marshall Islands would tend to increase, principally from civilian contractors (U.S. government employees pay income taxes only to the U.S. government) (USASSDC, 1993).

Potential spinoff effects could occur from technologies used for BM/C3 activities. Spinoff effects are defined as innovations in technology that can be reapplied to the needs of the consumer marketplace, thus creating new products, new companies, and new jobs that provide a significant boost to an economy and its international competitiveness (Haggerty, 1991). Commercialization of technologies is important to economic growth because the economic benefits of a technology accrue when a product, process, or service is brought to the marketplace where it can be sold or used to increase productivity. It is through further development, refinement, and marketing that the results of research become diffused throughout the economy, potentially generating growth. When technology transfer is successful, new and different products or processes become available to meet or generate market demand (Schacht, 1993).

K.4.1.2 Ground-Based Interceptor

GBI development and testing activities would be conducted at existing contractor and government facilities and would be considered new operations at these facilities. Locations could include sites close to small to large communities, including Vandenberg Air Force Base, Kauai Test Facility, and White Sands Missile Range. In addition, GBI activities could be conducted at USAKA. Potential operations at existing facilities could require approximately 50 personnel plus an undetermined amount of capital. Modification and construction activities would require minimal labor, capital, or land requirements, if any.

Required Factors of Production

At current projected GBI employment requirements, personnel requirements may be minimal for current operations at existing government facilities in small to large communities. Labor requirements, however, could be an issue in rural/small communities if the percentage of in-migrant labor is large for the resident labor force. The potential impacts in these communities are

unknown at the programmatic level and could require further analysis at the regional or local level.

In all community sizes, the primary issue for GBI development and testing activities is the amount of capital required to support operations. No adverse impacts would be anticipated if capital, raw materials, and other resources were imported from outside the region; however, environmentally related and direct infrastructure impacts from the use of these resources could occur, potentially requiring further analysis at the regional or local level (see above, Non-Local Sources). Secondary effects as well as environmentally related and direct infrastructure impacts might occur to community services if local capital were used, potentially requiring further analysis.

Factor Demand and Location Impacts. Potential locations include small to large communities, as well as USAKA.

Medium to Large Communities. The primary issue for medium to large communities is capital requirements to support operations. These areas tend to have available raw materials, equipment, and supplies to support operations because they typically have diversified economic bases and labor forces with inter-industry linkages. In these cases, the use of local capital might require further analysis at the regional or local level to determine secondary economic activity impacts as well as environmentally related and direct infrastructure impacts. Potential impacts to medium/large communities from the use of local capital could include:

- Secondary Employment Effects. Depending on capital requirements, these activities could infuse new purchasing power into a local economy from purchases of supplies and material to support development and testing activities. This increased volume for local trade and service firms could create additional demand for employees. Any increased labor requirements would likely be supplied from the resident labor force in medium to large communities.

- Environmental Impacts. The use of capital and raw materials could involve the introduction of hazardous material or pollution-emitting equipment into a local community. The use of these materials could affect the environment, which in turn, could impact a community's standard of living, economic structure, and demographic composition.

- Direct Infrastructure and Utility Impacts. An increase in the use of capital for additional equipment could require infrastructure or utility modifications. A community's infrastructure capacity might not be able to support development and testing activities.

For example, a facility might require additional electricity to support an activity. The community might need to upgrade its utility system to accommodate this modification.

Rural to Small Communities. Given current GBI requirements, the primary issue for rural areas and small communities is associated with importing capital, raw materials, and other resources and the potential effects on trade and distribution channels. These areas tend to have smaller, less diversified labor forces and economic bases with few inter-industry linkages. Further analysis at the regional or local level may be required to discern potential environmentally related and direct infrastructure impacts from the use of capital resources.

Further analysis might be required in rural areas for the in-migration of labor. Potential impacts from the in-migration of labor in rural areas would not be likely, but could occur depending on the site and composition of the labor force relative to labor requirements. If in-migration of labor occurs, potential impacts could include secondary employment effects, shortages of goods and services, and temporary housing shortages; however, these effects would be anticipated to be short-term, with the community adjusting to potential impacts in the long-run. The following impacts could be anticipated from in-migration (particularly in rural areas) and importation of resources:

- Secondary Employment. The in-migration of labor in rural areas could be anticipated to generate secondary employment from increases in purchasing power into the local economy. Procurement for goals and services in the region to support construction and operation demands of the GBI activity could also generate secondary employment.

- Public Finance. In-migrating population in rural areas could cause a change in local government expenditures which could be offset by an equivalent change in revenues. This activity could necessitate a change in existing fiscal policy or tax structures or cause a public entity to incur bonded indebtedness depending on public service capacities. If large increases in operational employment relative to existing employment are required, the community's tax base would increase over time as a result of new homes and business structures associated with the GBI activity; however, a lag could exist between the need for expanded services and growth of the tax base. Once the project is in operation and fully on the tax rolls, the fiscal outlook for local governments could improve substantially. These projects should have high capital/labor ratio and could generate considerable tax revenue (Murdock, 1979).

- Public Service Requirement Increases. In-migrating population could result in either increased requirement for public services that could be accommodated within existing budgets and would not require an internal transfer of funds, additional staffing, or major equipment. Alternatively, increased public services could be accommodated by additional major capital facilities if GBI related demand would require more services.

- Utilities. In-migrating population and/or commodity imports would have either no noticeable effect on operating practices and would not require additional equipment or facilities or would cause disruptions of service and degradation of existing performance characteristics, requiring new facilities and equipment.

- Transportation. In-migrating population and/or commodity imports cause either no changes in level of service and total travel time or significant changes in level of service and total travel time. In either case, the use of additional capital could cause changes in existing transportation conditions, requiring extensive reconstruction or substantial increases in the overall maintenance cycle.

- Nature of Community. The in-migration of a large number of persons in rural areas might not only change the size but also the nature of the community. The influx of large numbers of new persons into an area would likely alter the social and service structures of the community (Murdock, 1979).

- Environmentally Related and Direct Infrastructure Impacts. These impacts would be similar to those of medium and large communities.

- USAKA. Because of specialized program requirements, resources likely come from outside of USAKA; therefore, the levels of analysis and associated impacts would be similar to BM/C3 activities.

Beneficial and Spinoff Effects. Potential beneficial effects would be similar to BM/C3 activities.

K.4.1.3 Ground-Based Sensor

GBS development and testing activities primarily would be conducted at existing government and contractor facilities and would be considered new operations at these facilities. Locations could include facilities close to small to large communities, including USAKA. Potential operations at existing facilities could require approximately 100 personnel plus an undetermined

amount of capital to support these activities. Modification and construction activities would consist of construction of a prototype GBS test site at USAKA and construction and/or modification activities for a User Operational Evaluation/Engineering and Manufacturing Development facility.

Required Factors of Production

Similar to GBI activities, labor requirements for GBS operations would be minimal for current operations at existing government facilities in medium to large communities; however, labor requirements could be an issue in small communities if in-migration of labor is required.

The primary issues for GBS development and testing activities are the labor and capital requirements for construction activities and amount of capital required to support operations. No adverse impacts would be anticipated if local labor were used for construction activities. Further analysis might be required at the regional or local level if in-migration of labor were required for construction activities because potential secondary effects could occur from increases in employment and population; however, these activities would be short term. No adverse impacts would be anticipated if capital, raw materials, and other resources were imported from outside the region; however, environmentally related and direct infrastructure impacts from the use of these resources could occur, requiring further analysis at the regional or local level. Conversely, secondary effects as well as environmentally related and direct infrastructure impacts might occur to community services if local capital were used, resulting in further analysis at the regional or local level.

Factor Demand Linkage Location Impacts. Further analysis may be required since the use of labor and capital for operations and modifications/ construction could require either local resources or resources from outside the region.

Medium to Large Communities. Potential impacts to medium/large communities from the use of local capital would be similar to GBI development and testing activities.

Rural to Small Communities. In-migrating population and importing capital, raw materials, and other resources could occur in rural areas or small communities. In these cases, resources supplied from outside the region could require further analysis at the regional or local level. The effects from in-migration of labor would be minimal, but could occur, and would be similar to GBI development and testing activities.

In analyzing construction effects, it should be noted that non-local construction workers usually constitute a larger percentage of the

construction work force than local workers. (Workers are classified as local if their address at the time of construction is in the same town as it was before they began work on the construction project.) In addition, construction workers usually do not bring families; therefore, overall family sizes are smaller for construction than for operational workers. Construction work forces for most types of facilities would be several times larger than the operational work force but would be present in an impacted area for only a short period, whereas operational work forces might be quite small but would be required for the life of the facility (Murdock, 1979).

Since construction labor and capital requirements are unknown, potential impacts to rural areas or small communities for construction activities could include:

- Secondary Employment Effects. Depending on the duration of construction activity, short-term secondary employment could be generated by increased purchasing power in the local economy through consumption or expenditures made locally by construction workers. Procurement for goods and services in the region to support construction demands of the GBS element could also generate secondary employment.

- Shortages of Goods and Services. Since services and goods in rural/small communities could be limited, an increase in import demand could develop in the short term to alleviate potential shortages.

- Temporary Housing Shortages. Depending on duration of construction activity, short-term impacts would be anticipated during growth and decline cycles of construction activities. During the growth cycle, project demands may exceed the projected vacancy rates. It should be noted that vacant housing units in small communities may be of low quality, making potential shortages even greater (Murdock, 1979). During the decline cycle, excess supply resulting from decreases in project demand would result in increases in net vacancy rates; however, operations would be anticipated to absorb some vacant units. Impacts to housing would be short term because they would not extend beyond the construction period of the GBS project. Increased demand pressures leading to increases in housing costs and rental prices could occur during the period of construction activity. These pressures would most likely be reduced for the long term.

- Environmentally Related and Direct Infrastructure Impacts. These impacts would be similar to GBI activities and would involve importing large construction equipment.

- USAKA. Construction and operations impacts would be similar to BM/C3 activities.

Beneficial and Spinoff Effects. Potential beneficial effects would be similar to BM/C3 activities.

K.4.1.4 Space-Based Elements

Space-based element, development and testing activities, primarily would be conducted at existing government and contractor facilities and would be considered new operations at these facilities. Locations could include small to large communities. Potential operations at existing facilities would be anticipated to require minimal personnel plus an undetermined amount of capital to support these activities. These activities would require minimal construction activities, if any.

No adverse impacts would be anticipated if existing site personnel, facilities, and equipment were used because no direct or secondary employment and population effects would occur, regardless of context, intensity, or duration of activity. Potential economic impacts, technology spinoff effects and socioeconomic consequences from BMD requirements, relative, regional economic/demographic structure and composition, would be similar to BM/C3, GBI, and GBS activities.

K.4.1.5 Mitigation Measures

Mitigation measures would focus on communities with anticipated adverse impacts. To effectively manage potential impacts of NMD activities, local officials require timely and accurate information regarding the magnitude, location, and timing of NMD projects and their likely economic and social impacts. For example, when there are large numbers of in-migrants relative to the ability of community infrastructure to provide support, the social and psychological dimensions of community life become increasingly problematic (Finsterbusch, 1983). Further analysis at the regional or local level would assist in the planning process by projecting socioeconomic impacts and suggesting appropriate mitigation measures. Effective planning for projects at the local level requires systematic analysis of the economic impacts on affected regions. Systematic analysis of economic impacts, in turn, must take into account inter-industry relationships within regions because those relationships largely determine how regional economies respond to project changes (U.S. DOC, 1992). At the programmatic level, immediate mitigation for affected communities could include the following:

- Coordination with Local Jurisdictions. To reduce construction- and operation-related impacts, coordination with local communities could address potential impacts from increased labor and capital requirements. The extent and effect of growth due to NMD activities could greatly enhance the ability of affected jurisdictions to plan effectively. Useful planning would address changes in levels of service for housing, infrastructure, utilities, transportation, and public service and finance.

- Education on Potential Impacts. Where further analysis is not required for NMD activities, local communities could be educated on why particular NMD activities would not have adverse impacts on community services and economic activity. Where further analysis is required, local communities could be informed of site-specific projections that could determine the level of impact and required mitigation measures.

Further analysis at a regional or local level could discern adverse impacts from NMD Technology Readiness Program activities. At that time mitigation measures would be implemented to reduce potential impacts. Such measures could include the following:

- Enhancing Labor Force Availability. To alleviate potential impacts associated with the in-migration of labor, local labor-force availability could be increased through various employment training and referral systems. The goal of these systems would be to reduce the potential for in-migration of labor to support NMD activities.

- Supplying Temporary Housing. To reduce, or eliminate, potential housing impacts associated with construction activities, a housing shortage could be offset by supplying temporary housing (e.g., mobile homes) for construction workers.

- Coordinating with Local Jurisdictions Regarding Construction Activities. It may be necessary to coordinate with local jurisdictions regarding the minimization of construction-related problems. For example, work hours could be scheduled so that project-related employees would avoid normal current traffic peak hours.

- USAKA. Construction of additional housing units could be required to meet any increases in personnel associated with NMD activities; however, available land on USAKA is limited. Alternatives to housing construction include limiting the number of employees with families to reduce housing demand and using leased hotel ships to house temporary personnel, freeing some of the existing and planned space for more permanent

employees. At Roi-Namur, personnel could be housed in open barracks or tents during short periods of peak activity (USASSDC, 1993).

K.4.2 GROUND- AND SPACE-BASED SENSORS AND GROUND- AND SPACE-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

The types of potential socioeconomic impacts and mitigation measures in the development and testing life-cycle phase under this Alternative would not generally differ in character from those described in Section K.4.1 for the Preferred Action.

K.4.3 ALL GROUND-BASED SYSTEM ACQUISITION ALTERNATIVE

This Alternative would eliminate BM/C3 activities at USAKA (no GEP or Regional Operations Center) while increasing GBI activities (increases in number of GBIs), resulting in more ground-based facilities than the Preferred Action. Although more communities may be affected by these activities, the types of potential socioeconomic impacts and mitigation measures under this Alternative would be similar to those under the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

K.4.4 GROUND- AND SPACE-BASED SENSORS AND GROUND-BASED INTERCEPTORS SYSTEM ACQUISITION ALTERNATIVE

The types of potential socioeconomic impacts and potential mitigation measures under this alternative would be similar to those described for the Ground- and Space-Based Sensors and Ground- and Space-Based Interceptors System Acquisition Alternative.

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